TWENTY-SECOND ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF ONTARIO

1891.

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY.

TORONTO:
PRINTED BY WARWICK & SONS, 68 AND 70 FRONT STREET WEST.
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To the Honorable the Minister of Agriculture :

Sir,—I have the honor to present herewith the twenty-second annual report of the Entomological Society of Ontario. in accordance with the provisions of our Act of Incorporation.

The annual meeting of the Society was held in London, on the 25th and 26th of November, 1891 ; the lateness of the meeting being caused by the severe illness of our President, who was on that account unable to attend earlier. At this meeting many papers of interest were read, the reports of officers received, officers for the ensuing year elected, and general business connected with the conduct of the Society transacted. The first reports were also received from the sections engaged on other branches of science, by whose work the Society hopes to be much benefited. The various reports of the officers and sections, together with the audited annual statement of the Treasurer, the annual address of the President, the papers read at the annual meeting and the report of our delegate to the Royal Society of Canada, will be found in the following pages. There is also presented a full report of the very important meeting of the Association of Economic Entomologists held in Washington in August last, under the presidency of our Vice-President, Mr. James Fletcher. This Society was first organised in Toronto in 1889, and now includes amongst its members all the leading scientists in North America who are engaged in the study of practical entomology ; its proceedings are therefore of the highest interest and value to all concerned in any department of agriculture or horticulture.

The *Canadian Entomologist* continues to be issued regularly and is now the oldest Entomological publication in America. It numbers amongst its contributors the ablest students of the science in the United States as well as in Canada, and also some celebrated Entomologists in Europe.

I have the honor to be, Sir,

Your obedient servant,

W. E. SAUNDERS,

Secretary.

ANNUAL MEETING OF THE SOCIETY.

The annual meeting of the Entomological Society of Ontario was held in its rooms in Victoria Hall, London, on Wednesday and Thursday, November 25th and 26th, 1891; the President, Rev. C. J. S. Bethune, Warden of Trinity College School, Port Hope, occupying the chair.

On Wednesday morning, at 10 o'clock, a Council meeting was held, at which their annual report was prepared and adopted, the mailing list of the *Canadian Entomologist* was carefully gone over, and other business was transacted.

At 2 p.m. a general meeting of the Society was held, at which the following members were present :—The President; Rev. T. W. Fyles, South Quebec; Messrs. James Fletcher and W. H. Harrington, Ottawa; G. Geddes, Toronto; J. M. Denton, W. E. Saunders, J. A. Moffat, H. Stevenson, N. Stevenson, Foote and Roger, London.

ELECTION OF OFFICERS.

The following gentlemen were elected officers for the ensuing year :—

President—Rev. C. J. S. Bethune, M.A., D.C.L., Port Hope.
Vice-President—W. Hague Harrington, Ottawa.
Secretary—W. E. Saunders, London.
Treasurer—J. M. Denton, London.
Directors—Division 1—James Fletcher, F.R.S.C., Ottawa.
Division 2—J. D. Evans, Sudbury.
Division 3—Gamble Geddes, Toronto.
Division 4—A. H. Kilman, Ridgeway.
Division 5—J. Alston Moffat, London.
Librarian and Curator—J. A. Moffat, London.
Editor of the *Canadian Entomologist*—Rev. Dr. Bethune, Port Hope.
Editing Committee—H. H. Lyman, Montreal; J. Fletcher, Ottawa; Rev. T. W. Fyles, South Quebec.
Delegate to the Royal Society of Canada—The President.
Auditors—J. H. Bowman and W. E. Saunders, London.

REPORT OF THE MONTREAL BRANCH.

The following, the eighteenth annual report of the Montreal Branch of the Society, was read and adopted :—

The Council in submitting their report for the year 1890-91 are pleased to be able to state that the year has been one of decided progress.

Ten monthly meetings, most of which were well attended, have been held during the year; the June meeting, held at the residence of Mr Trenholme, Cote St Antoine being principally devoted to collecting moths.

The presence of Mr James Fletcher, Vice President of the parent society at the Febuary meeting, and of the Rev. Mr Fyles of Quebec, on several other occasions gave an increased interest to those meetings, and the Branch is indebted to these gentlemen for the interest they have taken in its success.

During the year, one old member Mr E. D. Wintle has rejoined, and one new one Mr H B. Cushing has been added to our roll.

The following papers have been read during the year :

1. Notes on Argynnis freya, A. Chariclea and A. Myrina. H. H. Lyman.
2. Notes on Coleoptera (several papers.) J. F. Hausen.
3. A Day in the Woods. Rev. T W. Fyles.

4. Notes on the Lepidoptera of 1890. A. F. Winn.
5. Description of a New Species of Pterostichus (P. Hornii.) J. F. Hausen.
6. Quebec representatives of the genus Plusia. Rev. T. W. Fyles.
7. Diseases of the Chrysanthemum caused by Insects, J. G. Jack, (selected.) F. B. Caulfield.
8. Tortoise Beetles. F. B. Caulfield.
9. On the occurrence of Gracilia minuta at Montreal. J. F. Hausen.
10. A preliminary paper on the genus Chionobas. H. H. Lyman.
11. Notes on Gryllidae, Field Crickets. F. B. Caulfield.
12. Notice of three new Species of Pterostichus. J. F Hausen.
13. Notes on some methods of collecting insects. H. F Winn.
14. Report on a collection of Lepidoptera from the north of Lake Huron. H. H. Lyman.
15. Can Insects survive freezing? H. H. Lyman.

Of the above, Nos. 1 and 9 have been published in the *Canadian Entomologist*; 3, 6 and 8 in the Annual Report for 1890; and 5 and 12 in the *Canadian Record of Science.*

The report of the Treasurer shows that the Branch is flourishing financially.

The Council would again urge upon the members increased activity in the collection and study of the insects of all orders in this locality, and especially of the more neglected ones, in order that we may obtain a better knowledge of those occurring here.

Only about 1,400 species are as yet recorded, and this number could be very materially increased by even one summer's careful work.

Your Council would suggest that occasional collecting excursions be held during the coming summer, as a means of stimulating the interest of the members in this science.

Respectfully submitted on behalf of the Council.

H. H. LYMAN, President.

The following officers were elected for the coming year:—President, H. H. Lyman; Vice President. F. B. Caulfield; Secretary-Treasurer, A. F. Winn; Members of Council, J. F. Hausen and W. C. Adams.

(Signed) A. F. WINN, Secretary.

REPORT OF THE TREASURER.

The Treasurer Mr. J. M. Denton, presented his annual statement of the finances of the Society and explained the various items to the meeting. On motion it was adopted as follows:—

RECEIPTS, 1890-91.

Balance from last year	$153 90
Membership fees	292 88
Sales of *Canadian Entomologist*	192 16
Pins, cork, etc	73 32
Government grant	1,000 00
Interest	6 07
	$1,718 33

EXPENDITURE, 1890-91.

Printing *Canadian Entomologist*, etc	$595 96
Report and meeting expenses	210 25
Library	33 55
Purchase of Collection	50 00
Expense account (postage, stationery, etc)	92 50
Rent	120 00
Insurance	35 00
Pins, Cork, etc	48 00
Grants to Editor and Curator	293 14
Balance	239 93
	$1,718 33

We certify that the above is a correct statement of accounts for the year ending August 31st 1891, of the Treasurer of the Entomological Society of Ontario, as shown by the books and vouchers.

(Signed) W. E. SAUNDERS,
J. H. BOWMAN.

REPORT OF THE LIBRARIAN AND CURATOR.

Mr J. A. Moffat presented and read the following report, which was, on motion adopted:

The library was completely gone over in the beginning of the year, and each book checked by its No. in the library register, when it was discovered that there were five volumes that could not be accounted for, viz: Nos. 100, 296, 619, 729, 994.

102 books, including a gift of 38 volumes from the President, have been added to the library during the year; the full number on the register being 1,168.

According to a suggestion at a previous meeting, a sectional catalogue has been commenced, which, if approved and published, will inform the members what books in the library deal with entomological subjects.

The number of volumes issued to local members during the year was 74.

Exchanges, such as reports and proceedings of societies, bulletins, magazines and periodicals of various kinds received during the year, average thirty per month.

As recommended by the Secretary, and approved of at the last annual meeting, an inventory of the back volumes of the *Canadian Entomologist* was taken. The information obtained thereby enabled the Society to offer some of the volumes to members at reduced rates, which were taken advantage of by many.

The Society's collection of native lepidoptera has been almost entirely renewed, and many additions made of recent captures, making it a good representative collection of Ontario lepidoptera up to date.

It is to be regretted that the coleoptera collection still remains in a very defective state, many blanks requiring filling in.

The other orders of native insects remain about the same, with no chance of extension, from a want of cabinet accommodation.

The exotics, so greatly increased by the purchase of the Pettit collection, have been made conveniently accessible, and have been a source of much interest and gratification to visitors.

A beginning has been made in arranging the European collection of coleoptera, which, when completed, will be valuable for reference, and the duplicates made available for sale or exchange.

An effort has been made to catalogue the wood-cuts and electrotypes, giving the No. of the drawer in which they are to be found, the name of what the cut represents, and the number of the annual report in which it has been described, which, when perfected, will enable anyone to trace the cut required with comparative ease.

Respectfully submitted,

(Signed) J. A. MOFFAT,
Librarian and Curator.

RESOLUTION *re* LIBRARY.

The following resolution regarding the library was adopted:—

That the chairmen of the various sections of the society, and the librarian be appointed a committee to draw up regulations for the use of the librarian, the same to be submitted for approval to the President and Mr. Fletcher, after which they shall be published with the catalogue.

It was also moved and resolved "that the thanks of the Entomological Society of Ontario be given to Professor Penhallow, of McGill University, Montreal, for interesting specimens of an East Indian Rhyncophorous beetle kindly presented by him to the Society's cabinet.

The reports of the sections of the Society being called for, Mr. Saunders presented and read the following:

REPORT OF THE ORNITHOLOGICAL SECTION.

To the Council of the Entomological Society of Ontario.

GENTLEMEN,—In presenting the first report of the London Ornithological Section of the Entomological Society, it is fitting that the Section should acknowledge its indebtedness for the privileges enjoyed and for the opportunity of organizing under the ægis of the Entomological Society. The advantages o being in touch with the more important of the other branches of natural history, and of having experts t refer to in matters of dispute or inquiry, are not easily overestimated. Under such circumstances t h section has made good progress during the time since its commencement. The membership, while not larg e is enthusiastic, and meetings, at which the attendance has been very good, have been held monthly or oftener, ever since inauguration. The section has compiled a list, presented herewith, of the birds breeding in Middlesex County, as well as supplementary lists of probable present and probable former breeders, of whose breeding we have not specific evidence. To this is added a short note on "Faunal Areas," from which point of view Middlesex occupies a peculiarly interesting position as a borderland, on which the different areas appear to meet.

(Signed) W. E. SAUNDERS, Chairman.
W. A. BALKWILL, Secretary.

In connection with this section a paper was read by Mr. R. Elliott on "Life Areas," referring to the distribution of birds in the neighbourhood of London; and a list was presented by Mr. W. E. Saunders of the various birds known to breed in the County of Middlesex.

REPORT OF THE MICROSCOPICAL SECTION.

Of the Entomological Society was presented and read by Mr. Foote, as follows:

As no report of the meetings since organisation has been made to the Society, I have much pleasure in presenting the following:—

Upon March 15th, of last year (1890) a meeting was held in these rooms to consider the advisability of organizing a microscopical section. Prof. Bowman was elected chairman *pro tem.* The meeting was called at 8 o'clock. Those present, Messrs. Bowman, Dearness, Arnott, Stevenson, Foote, Magee, Wilson, and Drs. Hodge, Gardner, Arnott and Hotson, all expressed their opinion in favour of the movement, and the section was fully organized, appointing Mr. Denton permanent chairman. Meetings were held regularly upon the second and fourth Friday of each month, from that time till postponement at last general meeting, held in April, and opened again upon Friday, Oct. 9th.

The meetings and attendance are as follows:

12 regular meetings; 4 open, (3 for the public, and one for the benefit of the ladies of Hellmuth College).—Total, 16 meetings and one outing. Average attendance of members, 10.

The following are some of the subjects taken up. For a fuller report I refer you to the minute book:—

Manipulation of the Microscope
Angular Aperture
Chromatic and Spherical Aberration.
Test objects—Pleurosigma, Heliopelta. } Prof. BOWMAN.

Mounting and Mounting-media—Mr. BURKHOLDER.

Fungi—Mr. J. DEARNESS.

Examination of Algae, Spyrogyra, Draparnaldia,
Oscillatoria; A Sexual division of Spyrogyra. } Mr. BURKHOLDER.

Black Knot—Mr. J. DEARNESS.

Fertilisation and Growth of Ferns
Structure of an Exogen. } Mr. J. DEARNESS.

Examination of the results of an outing to the ponds—Daphnia, Cyclops—an unknown larva found in the pitchers of the pitcher plant. Drawings were taken for future reference.

LONDON, Nov. 25, 1891.

REPORT FROM THE ENTOMOLOGICAL SOCIETY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA.

BY THE REV. THOMAS W. FYLES, F. L. S., DELEGATE.

Canadian Entomology is the outgrowth of the last thirty years, and in its development the Entomological Society of Ontario has played no unimportant part.

The first movement towards the formation of this Society was made in 1862; and at that time according to the statement of the naturalist Grote (19th Report of the Entomological Society of Ontario, p.62), there were probably not one hundred species of Lepidoptera named and determined in any collection on this continent. The Society was fully organized on the 16th of April, 1863. In August of 1868 it commenced the publication of its monthly organ, the *Canadian Entomologist*, which ante-dated by one month the *American Entomologist*, edited by Walsh and Riley. In 1871 the Society was duly incorporated, and since then, under the fostering care of the Ontario Government, it has maintained its important position as one of the leading Entomological societies on the continent of America.

One of the conditions of the Act for its incorporation, was, that it should present to the Minister of Agriculture for Ontario, an annual report of its proceedings. Twenty-one such reports have now been issued, the whole embodying a vast amount of valuable entomological information.

The report for 1890 contains an account of the proceedings at the annual meeting of the Society, the address of the president, and the various reports and papers read on that occasion. It contains also, full and interesting notes of the proceedings at the Indianapolis meeting of the Entomological Club of the American Association for the advancement of Science, and of the American Association of Economic Entomologists held at Champaign, Illinois. These notes were presented by Mr. Fletcher, who had attended the meetings of the associations as the Society's representative. They are followed in the report by various original papers, thought to be of interest both to entomologists

and to the general public. The titles to these are: "Kitchen Garden Pests and How to Deal with Them"; "An Outbreak of the Army Worm in Maryland"; "Tortoise Beetles"; "Quebec Representatives of the Genus *Plusia*"; "Origin and Perpetuation of Arctic Forms"; "Fuller's Rose Beetle"; "Hymenoptera Parasitica"; "Insects Injurious to the Elm"; "The Entomology of Shakespeare"; and "Experiments for the Destruction of Chinch Bugs." The rest of the report is made up with selections, and notices and critiques of the most important entomological publications that had appeared in the course of the year.

The *Canadian Entomologist* has reached its twenty-third volume. It is still under the able management of the Rev. Dr. Bethune, D.C.L. It has now been permanently enlarged to twenty-four pages, and "continues to receive contributions from all the most eminent entomologists in North America, and to circulate in all parts of the world." (21st report, introductory letter from the Secretary to the Honorable the Minister of Agriculture). In the volume for 1890, articles appear from thirty-five contributors who are pursuing their investigations in various parts of British North America, the United States of America, Great Britain, British India and Germany. No less than seventeen new species of insects are described in its pages.

The constitution of the Society provides for the formation of branch associations; and in Montreal an important branch has flourished for a length of time. It was chiefly through the instrumentality of Mr. F. B. Caulfield, that this branch was called into existence; and it still enjoys the benefit of his services as vice-president. Under the presidency of Mr. H. H. Lyman, the branch is raising up a number of young and enthusiastic entomologists who give promise of attaining eminence in their favourite pursuit. At its monthly meetings original papers have been read, and descriptions of several species of beetles discovered by Mr. J. F. Hausen, one of its members, have been given. The secretary of the branch is Mr. A. F. Winn.

The scheme for the formation of sections, which was put into operation last May, continues to work admirably. The sections formed in London, the head-quarters of the Society, are four:—the Botanical, the Ornithological, the Geological and the Microscopical, all of which are doing good work. The value of all these sections to the parent society will be readily perceived: of the Botanical, in determining the food plants of insects, and in tracing insect ravages and their effects; of the Ornithological, in discovering what insectivorous birds act as checks upon the undue increase of particular kinds of insects, and in answering such inquiries as that which called forth a volume from the United States Agricultural department—whether the English sparrow (which was said to destroy large numbers of injurious larvæ) was of benefit to the community or not; of the Geological, in showing what kinds of soils are favourable to the growth of certain food plants, and thus indicating the localities for particular insects, and also in tracing the impressions left by extinct species in various Geological formations; and the Microscopical, in noting the structural peculiarities of insects, and in aiding to classify minute forms.

The Botanical section numbers 16 members. Its chairman is Mr. J. Dearness; vice-chairman, Professor Bowman, and secretary, Dr. S. Carson. Meetings for study and mutual assistance are held by it every Saturday evening, from 1st of May, until 1st of October. A number of excursions have been carried out, and some new species added to the already well examined flora of the environs of London. Two new mosses have been discovered by Mr. Dearness, and a surprisingly large number of new fungi—more than 60 now named, and some yet unnamed. These fungi are for the most part new not to Canada only, but also to the whole of America.

The Ornithological section also is flourishing. It is engaged in gathering up facts of general import to ornithology, and is commencing a systematic list of the breeding-birds of Middlesex county to be presented at the annual meeting of the Society. Its chairman is Mr. William Saunders, and its secretary, Mr. N. O. Balkwell.

The Geological section has nine members. Dr. S. Wolverton being chairman, Mr. T. Green vice-chairman, and Mr. J. L. Goodburne, secretary. The members have made regular weekly excursions, and the district around London has been well worked by them,

and numerous interesting fossils have been added to the Society's collections; taken altogether the year's work done by this section has been very satisfactory. The interest of the members has not flagged at any time, but each has seemed anxious to do what he could towards adding to the general stock of information.

The Microscopical section has also been active. It numbers twelve members, and it has in use eleven first-class microscopes. Ten meetings have been held by the members for private study, and two public entertainments for the benefit of the young people of the city have been given. Special attention has been paid by this section to fungi, mildews upon fruit-trees, rust in wheat, etc. Mr. John Denton is chairman of the section, and Messrs. Bowman and Dearness, microscopical directors.

It is generally conceded that the formation of these sections was a happy procedure that strengthened the Society and increased its usefulness.

At the last annual meeting the Society secured the services of Mr. J. Alston Moffatt one of its members who engaged to take entire charge of the Society's rooms, library and collections, and to be a permanent resident official in London. It is felt that the greatest care will be taken by Mr. Moffatt for the preservation and arrangement of the Society's valuable collections of insects. These have lately been enlarged by the purchase from Mr. Johnson Pettit of Grimsby, of several well filled and well-arranged cabinets of coleoptera, etc., the results of many years' intelligent labor on the part of Mr. Pettit.

Among the tokens of public recognition of the value of its collections, the Society preserves the medals and diplomas awarded it at the Centennial Exhibition, Philadelphia, in 1876, the International Fisheries Exhibition in 1883, and the Colonial and Indian Exhibition in 1886.

The library of the Society now numbers 1,100 volumes. Among them are such costly works as the Challenger Reports, 20 vols.; Smith's Collection of Abbott's Illustrations, 2 vols. 1797; Drury's Exotic Entomology, 3 vols.; Stephen's Entomology, 8 vols.; Kirby's Entomology, 4 vols.; Say's Entomology, 2 vols.; Edwards' Butterflies of North America, 2 vols.: Scudder's Butterflies of New England, 3 vols.; McCook's American Spiders, 2 vols.; Packard's Monograph of Geometrid Moths; Lord Walsingham's Illustrations of Typical North American Tortricidæ, 2 vols.; The American Naturalist, 20 vols.; Scudder's Fossil Insects, 2 vols., etc. It is being continually enriched by the printed reports and periodicals from the principal Entomological societies of Great Britain, Australia, Austria, France, Germany, India, Italy, Russia, Switzerland, South America and the United States of America.

The Society's collections, library, electrotypes, etc., are insured for $3,500.

The Society reports, through its president, the unwelcome re-appearance of the Hessian fly (*Cecidomyia destructor*, Say), and recapitulates the best methods of dealing with this pest.

Another intruder that has been brought under the notice of the Society is the grain Aphis (*Siphonophora avena*, Fab.), which has appeared in many localities in Ontario.

The Larch saw-fly (*Nematus Erichsonii*, Hartig.), after doing incalculable harm to the tamarack forests of Canada, is now diminishing in numbers. A new importation allied to this (*Nematus pallidiventris*, Fallen) has made its appearance on willows brought from Russia by the late Mr. Charles Gibb.

The Mediterranean Flour Moth (*Ephestia Kuhniella*, Zeller) whose appearance two years ago in a large milling establishment in Ontario, caused so much consternation, and called forth such vigorous action on the part of the Ontario Agricultural Department seems happily to have been stamped out.

In these days of rapid transit and intercourse with foreign countries, the advent of new insect pests may be looked for. According to a wise provision the directors of the Society must be representatives from the different Agricultural sections of Ontario. By this arrangement it is hoped the appearance and operations of injurious iesects in any part of Ontario will be speedily made known to the Society, and receive careful attention.

The Society has noted with the greatest satisfaction the valuable work done by Mr. Fletcher, the Dominion Entomologist at Ottawa, who, by his entomological publications and his public addresses in various parts of the country, is diffusing knowledge that will be of the utmost importance to the community. The president of the Society has truly said that "the result of his work must in course of time be the saving of hundreds of thousands of dollars to the farmers and fruit-growers of the Dominion." (President's address, 21st annual report, p. 10).

A paper by Mr. H. H. Lyman, of Montreal, on "Pamphila Manitoba, Scudder, and its varieties," was read by the President, in the absence of the writer.

Various matters of interest were then brought up and discussed by the members present. Among them may be mentioned a consideration of the prevalence of the destructive Locust (or Grass-hopper) in some of the North-western States, and the probabilities of a further attack next year. The successful use of "Hopper-dozers" was mentioned, and much credit was given to Mr. Lawrence Bruner for his valuable investigations. The occurrence of an imported species of Saw-fly on the European alder was noted; and mention was made of the destruction of Hawthorns (*Cratægus*) by the beetle *Anthonomus quadrigibbus*.

Mr. Fletcher exhibited a specimen of *Vanessa Californica*, taken by Mr. W. H. Danby on Vancouver Island, September 20th, 1890, being the first recorded capture o this butterfly in Canada. He also exhibited (1) a very rare and extraordinary beetle, taken by Prof. John Macoun, in 1887, at Victoria, B.C.; it is a large longicorn, but with its short wing-covers looks more like a rove beetle (*Staphylinid*); its name is *Ulochætes leoninus*: (2) a specimen of the mole-cricket (*Gryllotalpa borealis*), which was taken at Leamington, in the County of Essex, by Mr. W. W. Hilborn, and gave an account of its curious and interesting habits: (3) a specimen of the pupa of *Chrysophanus thoe*, which he had raised from the egg; he procured from a pair of the butterflies in captivity twenty-four eggs, of which one hatched and went through all its larval stages to the pupa, feeding on dock (*Rumex*); the remaining eggs will evidently remain dormant till next spring: (4) a specimen of the cut-worm *Agrotis ochrogaster*, Guen, which is so injurious in the North-West, and compared it with *A. turris*, Grote; he stated that all grades of variation between the two forms had been obtained from one brood of the caterpillars, and that it was now accepted that they were all of one species, which should be known by the former name.

Mr. Fyles exhibited specimens of (1) *Colias interior* and *C. philodice*, var. *Laurentina*; (2) *Lycæna Couperi*, taken at Brantford, Ontario, regarding the identity of which with the southern form, *L. Lygdamus*, a discussion took place, leading to the conclusion that they were local forms of the same butterfly: (3) a "hair-snake," (*Gordius*), ten inches long, taken from the body of the larva of an *Acronycta*, which was remarkable, as these creatures are usually found infesting grass-hoppers and crickets of the order Orthoptera.

The meeting adjourned at 5.30 p. m.

EVENING SESSION.

In the evening the Society held a public meeting in its rooms at Victoria Hall which was largely attended by members and other friends from London and the neighbourhood, amongst whom the following were noticed:

Mr. James Fletcher (Vice President), and Mr. W. H. Harrington, of Ottawa; Rev. T. W. Fyles, of South Quebec; Captain G. Geddes, of Toronto; Messrs. J. M. Denton, W. E.

Saunders, J. Alston Moffatt, Rev. W. M. Rogers, Dr. Woolverton, Dr. Wilson, Prof. J. H. Bowman, J. Dearness, H. Stevenson, W. Stevenson, D. Arnott, W. Foote, W. Scarrow, and — Ware, of London.

The Rev. Dr. Bethune, Warden of Trinity College School, Port Hope, President of the Society, took the chair at 8 o'clock.

The annual report of the Council was read, and upon motion by Rev. T. W. Fyles, seconded by Prof. Bowman, it was adopted and referred to the Editing Committee for publication.

—

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario beg to present the following report of their proceedings during the past year :—

They are happy to be able to congratulate the members of the Society upon the large increase in numbers during the past year, and the continued interest that is taken in its various departments of work.

The Twenty-First Annual Report on Economic and General Entomology was sent to the Minister of Agriculture in December last, and was printed and distributed in the following April. It consisted of 105 pages, illustrated with 47 wood cuts, and contained many useful and valuable papers.

The *Canadian Entomologist* has been regularly issued at the beginning of each month ; the December number, which will complete the twenty-third volume, is now passing through the press. It is now the oldest publication of the kind in North America, and continues to maintain a high reputation among scientific entomologists, both from the value and interest of its papers and the eminence of many of its contributors. The number of pages has been much increased in the current volume. Nearly every issue has contained from 20 to 24 pages, and that for November extended to no less than 34. The whole volume will consist of over 280 pages, being more than forty in excess of the usual number.

Over one hundred volumes have been added to the library during the past year, including a handsome gift of 38 volumes from the President. Among the purchases may be mentioned the valuable work, by Mr. S. H. Scudder, on the Fossil Insects of North America, in two volumes, quarto.

A large and valuable addition to the cabinet of the Society has been made by the purchase of Mr. J. A. Moffatt's collection of *Lepidoptera*.

The following sections of the Society have been in active operation during the past year, viz.: The Botanical, Geological, Microscopical, and Ornithological. The reports of their proceedings are submitted herewith. It is gratifying to find that the formation of these sections has proved so successful and that it has led to an increase of our numbers and the performance of much valuable work. It is earnestly hoped that all persons interested in natural science, in London and the neighbourhood, will become members of the Society, and take part in the proceedings of one or more of the sections.

During the month of August important meetings were held at Washington, D.C. The Association of Economic Entomologists was presided over by our Vice-President, Mr. Fletcher, and was the most important, and the best attended, of any hitherto held in North America. A full account of its proceedings will be published in our annual report. At the meeting of the Entomological Club of the American Association for the Advancement of Science, Mr. Fletcher acted as our representative, and has given a report of the papers and discussions in the October and November numbers of the *Canadian Entomologist*.

The reports of the Montreal Branch, and of the Rev. T. W. Fyles, delegate to the Royal Society of Canada, are presented herewith. The accounts of the Treasurer, and the reports of the Librarian and Curator are also submitted.

The Council desire to express their satisfaction at the manner in which the Curator has discharged his duties during the past year, in the care and arrangement of the library and cabinets, and of the rooms of the Society.

All which is respectfully submitted.

CHARLES J. S. BETHUNE,
President.

ANNUAL ADDRESS OF THE PRESIDENT.

The President cordially welcomed all present and proceeded to deliver the annual address upon the chief topics of entomological interest which had taken place during the year.

GENTLEMEN.—I have much pleasure in welcoming you all to the annual meeting of our Entomological Society. I am sorry that we have been unable to hold it at an earlier and more favourable period of the year, and that we should thus be debarred from having an outing together, like that of our memorable field-day last year. I was unfortunately laid up with a severe illness during the latter part of the summer, and my colleagues thought that it would not be advisable to hold this meeting without your President; it was consequently postponed to this late date. Owing to my being confined to my room for so long a time, I can only give you a meagre account of the principal events of the year in the entomological world. In doing so let me first refer to the most noteworthy injuries caused by insects during the past season.

The most serious insect pest of the year to the fruit grower in Canada was "the Eye-spotted bud moth," (*Tmetocera ocellana*, Schiff). This tiny insect (Fig. 1) has become very abundant of late and very widespread throughout the country. In Ontario, Quebec, New Brunswick and Nova Scotia it has been very injurious to the apple. The crop of fruit this year has been so unusually large that the loss occasioned by this insect has not, perhaps, been much noticed, but it is much to be feared that if it should be let alone to increase and multiply undisturbed, its ravages will become very serious and very conspicuous in the future. The object of attack, as the name of the insect indicates, is the opening bud of the apple; this is pierced by the young caterpillar, which forms a habitation for itself by drawing together portions of a dried and blackened leaf and lining them with silk to form a protecting case. As it grows larger, the worm often destroys a whole cluster of blossoms or of young fruit by drawing them together with silken threads and devouring the stems and foliage to such an extent that they wither and die. It occasionally also eats into the extremity of the twig from which the blossom proceeds, and by boring into it causes the destruction of the bloom and all hope of subsequent fruit. The caterpillar is of a dull brownish colour, with a few short hairs on its body proceeding from tiny warts. It usually becomes fully grown in June and forms its chrysalis in its larval case, from which the moth emerges in July. This is a pretty little creature, ashen gray in colour with a broad whitish band across the middle of the anterior wings. Its specific name is derived from the two little eye-like spots on each of these wings. A good deal may be done to check the spread of this insect by pulling off and crushing the clusters of withered leaves containing the caterpillars, but the best remedy is no doubt the spraying of the trees in early spring with a weak mixture of Paris green and water, not more than one quarter of a pound of the poison to fifty gallons of water, but it would be well to begin with a lower strength than this for fear of injuring the foliage of the trees.


Fig. 1.

Closely associated with the insect I have just referred to is "the Lesser Apple-leaf Folder" (*Teras minuta*, Robs), which has also been very abundant this year, (Fig. 2). The caterpillars of this insect appear in early spring and commence their depredations upon the tender foliage which has just come forth from the opening buds. They draw the opposite sides of the leaves together to form a habitation, and devour the foliage nearest to them. When they occur in large numbers they cause the trees to look as if they had been scorched by fire at the extremity of the branches. The moth is about a third of an inch long, with bright orange fore wings and silky white hind wings. There are two broods in the year, the first moth appearing early in spring and the later ones towards the end of July.

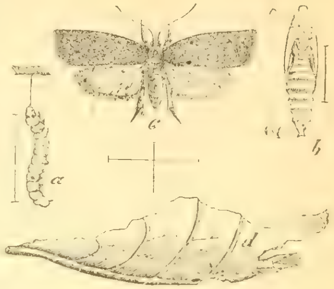

Fig. 2.

The larvæ of another and larger moth, "the Oblique-banded Leaf-roller," (*Cacœsia rosaceana*, Harris), have also been very numerous and destructive. This insect feeds upon a large variety of plants, both fruits and shrubs, but has been especially injurious to the apple during the past season. Like the two species already mentioned, it begins its attack in early spring by rolling up the young leaves of the plant and fastening them with silken threads. In the hollow cylinder thus formed the caterpillar (Fig. 3) takes up its abode, and when disturbed at one end quickly slips out at the other and lets itself down and away from the threatening danger by means of a silken thread. There are a great many species of leaf-rollers known to entomologists—they belong to the family of Tortrices and are well represented everywhere. Their habits are much the same in all cases, and when numerous they become a positive injury to the plants they attack. The moths may be at once recognized by their peculiar flat shape, resembling the outline of a bell when the wings are closed, (Fig 4) and having the outer margin of the fore wings wavy (Fig. 5.) In the species now referred to the fore wings are of a cinnamon or brown colour, and the hind ones a lighter yellow. The best remedy for this insect and the leaf-folder is the use of Paris green in the manner I have already described.

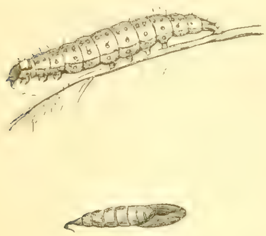

Fig. 3.

Fig. 4.

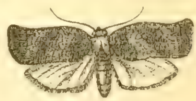

Fig. 5.

Canker-worms, the larvæ of the moths *Anisopteryx vernata*, Peck and *A. pometaria*, Harris, which are injurious almost every year in the Maritime Provinces, have this year been injuriously abundant in the eastern counties of Ontario, and have also been particularly destructive at Winnipeg, where they have in many cases stripped of their foliage the large trees of the ash-leafed maple which are there grown in the streets for shade. There are two classes of remedies for these insects. The object of one is to prevent the wingless female from climbing up the trees from the ground in order to lay their eggs after their emergence from the chrysalis state, which they pass in the earth. A common mode of doing this is to encircle the trunk of the tree a short distance above the ground with a band of cloth or thick paper, folded to a width of four or five inches and thickly smeared with tar or a mixture of tar and molasses. This should be applied to the tree in the autumn and kept on till the leaves are expanded in the following spring. The tar requires to be renewed from time to time, and should be looked to whenever any mild days occur at the beginning or close of winter. Tin and wooden troughs filled with oil have been used for the same purpose; also collars of tin, sloping downwards like an inverted funnel have been found effective in preventing the female moths from ascending the trees. The other style of remedy is that directed against the caterpillars when they

have gained possession of the trees, and consists of spraying the trees with Paris green or London-purple—a method that may be very properly described as a universal remedy for all foliage eating insects.

The irrepressible Cut-worm has made his unwelcome presence known in many parts of the country. In Alberta territory they were very numerous and destructive in the early part of the season. In reply to an appeal for instruction in the modes of dealing with this pest made by the editor of the Macleod *Gazette*, I sent him copies of our last report and Mr. Fletcher's bulletin containing directions upon the subject, and advised him strongly to have the poisoned traps used by the farmers in the neighbourhood. The remedies were duly published in the *Gazette* and I have no doubt were found very effective by those who tried them. The species of cut-worm in question is evidently *Agrotis ochrogaster*, Guen, which has also been found in abundance at Lethbridge. Its habit is to attack vegetation of every description, and thus it may be rated as one of our most destructive species. It is evidently very widely diffused throughout the Dominion, as it has been found in abundance at Cape Breton. In Manitoba another species, *Agrotis campestris*, Grote, has been most prevalent and injurious.

The insect producing the well-known injury called "silver-top" in grass (*Meromyza Americana*) was very abundant this year in many districts of Ontario. In most instances it was attended by its parsite (*Cœlinius meromyza*, Forbes), which may be relied upon to keep it in check eventually. In the meantime it will be wise for farmers to break up their old meadows, wherever "silver-top" has appeared, and put in a crop with plenty of manure.

The turnip flea-beetle, (*Phyllotreta vittata*, Fab.) is almost ubiquitous and always injurious. Sometimes it is so numerous on the plants that on the approach of a disturber it hops off from leaf to leaf with the pattering sound of fine rain or hail. This year it has been abundant in some localities and requires measures for its destruction. In this country, where it is not the practice to feed sheep upon the turnips in the field, it is quite safe to employ a mixture of Paris green and land-plaster in a proportion of one hundred times the quantity of the latter to that of the former. The best time to apply the poison is when the leaves of the plant are wet with dew.

Another "pestilent fellow" that requires constant watching is the pea-weevil (*Bruchus pisi*, Linn) (Fig. 6.) It appears, unhappily, to be on the increase in this Province. As large quantities of choice varieties of peas are grown in order to export the seed, it is a very important matter that they should be perfectly free from this pest. The first precaution to be taken is to make sure that the seed intended to be sown is free from the weevils; in fact, this is about the only thing that can be done owing to the habits of the insect and its working inside the pod. Should the seed be found to be infested with the weevils, the utmost care should be taken to kill them. There are several modes of doing this, but the most effectual is to place the seed in a perfectly tight vessel and to put on the top of the peas a saucer containing a little bisulphide of carbon—one quarter of a pound is enough for three hundred weight of peas. This substance, when exposed to the air, becomes converted into a gas, which being heavier than the atmosphere, sinks down through the mass of peas and kills all living things exposed to it. It is necessary to exercise the utmost care in its use as it is highly inflammable and any light brought near it will cause an explosion. It is advisable, therefore, to put the peas to be treated into a barrel or other receptacle that can be moved out of doors before the cover is taken off.

Fig. 6.

The next insect on my list of the troublesome is the striped cucumber beetle (*Diabrotica vittata*, Fab.), a little yellow-striped creature (Fig. 7) that is no doubt familiar to everyone. Dr. Weed, of the Ohio State Experiment Station, has satisfactorily shown by a series of careful experiments that the best mode of preventing injury from this insect is to so protect the plants that the beetle cannot get at them, and that this can be most cheaply and successfully done by "protecting each hill by a piece of plant-cloth, or cheese-cloth, about two feet square. This may be done simply by placing it over the plants and fastening the edges down by small stones or loose earth. It is better, however, to hold it up by means of a half barrel hoop, or a wire bent in the form of a croquet arch."

Fig. 7.

The Pear-tree slug (*Selandria cerasi*, Peck), Fig. 8, has been very abundant and injurious in many quarters, completely destroying the foliage of cherry as well as pear trees. It is too familiar a pest to require description at my hands. An effective remedy has been found in the application of a weak mixture of Paris green and water. Last year I referred to the exceeding abundance in all parts of this Province of the fall web-worm (*Hyphantria textor*, Harris). I regret to say that this year it has been more abundant than ever, so much so that it may be regarded as the most noticeable attack of the season. It has become widespread throughout Canada and the United States as far south, at least, as Virginia.

Fig. 8.

The larch saw-fly (*Nematus Erichsonii*) continues to be very abundant and destructive. Unfortunately it is a kind of attack for which there seems no practicable remedy.

The tent-caterpillars (*Clisiocampa*) have again, I am happy to say, been conspicuous by their absence. It is to be hoped that this immunity may long continue.

The oyster-shell bark-louse (*Mytilaspis pomorum*, Bouché), Fig. 9, has become very injurious in orchards and gardens, but few fruit-growers seem to realise how much injury it occasions, because it is so inconspicuous. Scraping the bark of the trunk and larger limbs, or scrubbing them with strong soapsuds will be found useful, but when the insect covers the smaller branches and twigs, as it soon does when undisturbed, it becomes necessary to resort to some other method of treatment. Syringing with a kerosene emulsion just before the buds burst in the spring, or late in the autumn immediately after the fall of the leaves, will be found most effective.

Fig. 9.

As far as I have been able to ascertain, these are the most noteworthy insect attacks of the year. There have been, no doubt, many others in particular localities, but these that I have referred to were for the most part widespread and general.

You will probably have noticed that I have given Paris green as the remedy for most insect pests. Its use has now been pretty thoroughly tested both here and in the United States, and there is no doubt that it is by far the simplest and most effective remedy for the codling-moth of the apple, the plum curculio, and all leaf-eating insects. It is, of course, absolutely necessary that great care should be exercised when handling so virulent a poison, to prevent injury to human beings or animals, and that the directions given by skilled entomologists, who have made careful experiments, should be strictly carried out. It must also be borne in mind that satisfactory results cannot be expected without the use of proper pumps and nozzles. The great point to be aimed at is to envelop the tree in a fine mist of the poisoned mixture, not to simply cause the foliage to drip from the squirting of a stream of the liquid. For full information regarding desirable appliances for this purpose and the quantities to be employed, I would refer those interested to the Bulletin No. 11, issued by the Central Experimental Farm at Ottawa, and prepared by Mr. Fletcher. It is entitled "Recommendations for the Prevention of Damage by some Common Insects of the Farm, the Orchard and the Garden." It is a most admirable little manual, and

contains within its thirty pages a wonderful amount of concise information regarding our commonest insect pests and the best way to deal with them. If any intelligent farmer or gardener will faithfully carry out the directions given, he will reap an abundant reward in the saving of a very large percentage of his crops or fruits, and he will at the same time gain a practical knowledge of insects that will stand him in good stead all the days of his life. If Mr. Fletcher had done no other work, and we all know how much valuable work he is always doing, the preparation of this little treatise would amply justify his appointment as Dominion Entomologist.

I hope that I have not wearied you with so much practical entomology to-night, but there is no doubt that our department of science is just now more concerned with economic rather than with technical investigations. An evidence of this may be found in the record of the proceedings of the meeting of economic entomologists held at Washington in August last, under the presidency of our colleague, Mr. Fletcher. It was a remarkable meeting, both as regards the number of distinguished scientists who were present, and the ability and usefulness which characterised the large number of papers read and the discussions that resulted from them. I trust that a full account will be published in our forthcoming annual report.

Since our last annual meeting many publications on economic entomology have been issued from the press, for the most part in the form of bulletins prepared by the entomologists attached to the Experiment Stations in various States of the Union. They are too numerous to mention in detail, but are always useful and interesting, and in many cases most valuable contributions to the knowledge of the subject. The Division of Entomology at Washington must not be overlooked when referring to work of this kind. Besides the publication of *Insect Life*, which is by far the best periodical of its kind that we have ever seen, many valuable papers on both scientific and practical entomology have been issued.

About ten years ago (in 1881) what was then called the United States Entomological Commission, consisting of Messrs. Riley, Packard and Thomas—three very eminent men—issued a work by Dr. Packard on "Insects Injurious to Forest and Shade Trees," (Bulletin No. 7), a goodly volume of 275 pages, well illustrated and replete with valuable information. Recently a revised and much enlarged edition of this work has been issued by the Department of Agriculture at Washington, bringing the original work more nearly down to date, and furnishing, as far as is possible, a complete manual on the subject. The new volume is more than three times the size of the former edition, consisting of no less than 950 pages, illustrated by over 300 wood-cuts and 40 plates, 12 of which are coloured. Some idea of the extent of the work, as well as of the importance of the subject, may be formed when I mention that descriptions are given of over 300 species of insects that affect the oak, and the names of nearly 150 more are mentioned; 61 are described as attacking the elm, and 30 more mentioned; 151 described that affect the pine, and a list of 20 more given; and so on for a large number of other trees. Economic entomologists for the most part devote their attention to the insects that attack fruit trees, crops and vegetables, as these most directly affect the public; but surely no more important matter can be studied than the preservation of our forests, which are annually being depleted for the purposes of commerce, as well as by fire and insects. It is high time that more attention was paid to this matter, and that people generally should be aroused to the dangers that will surely result if we allow our country to be stripped of its woods and forests. In some countries of Europe, notably in Germany, a very rigid oversight of the forests is maintained by the Government, and no wanton or careless destruction is permitted. In connection with this, they encourage scientific men to devote their studies to the insect enemies of the trees, and as a result some magnificent books have been published. Chief among these are the grand work of Ratzeburg, and the perhaps less widely-known publications of Kaltenbach. Along side of these Dr. Packard's book will assuredly take its place.

Miss E. A. Ormerod, we are happy to say, continues her valuable work in England with unceasing devotion and industry. It is gratifying to know that the difficulties which led to her resignation of the office of Consulting Entomologist to the Royal

Agricultural Society have been satisfactorily composed, and that the Society, having apologised for the action which led to her resignation, will now be able to count once more upon her invaluable assistance in all matters that relate to practical entomology. A very remarkable testimony to her ability and worth was afforded by the British press when the fact of her resignation was first made known. The leading agricultural journals and the newspapers, including the *Times*, spoke in warm terms of her merits and deprecated the action of the Society; social papers, such as the *Queen*, discussed the case and took up the cudgels in her defence; and all alike bore lively testimony to the inestimable value of her services.

Her sister, Miss Georgiana E. Ormerod, has recently published a series of colored diagrams of insects injurious to vegetation; they are 30 in number, and include all the most prevalent attacks upon crops, fruits and trees. They are beautifully executed and will be found most useful for the illustration of lectures to classes or addresses to farmers' institutes. Though intended for England, nearly all of them are equally applicable to this country.

In technical entomology the year has been marked by the publication of Mr. S. H. Scudder's grand work on Fossil Insects of the Tertiary Period. He has devoted to its preparation about a dozen years of patient toil, and it stands forth in conjunction with his marvellous volumes on "The Butterflies of the New England States and Canada," as a monument to his great ability, industry and learning. In this work he gives descriptions of no less than 612 species, for the most part collected in Colorado, Wyoming and British Columbia, with some from Pennsylvania, and Scarborough in this Province. Nearly all the species are beautifully figured on large lithographic plates.

Mr. W. H. Edwards continues to issue his work on "The Butterflies of North America," with its unsurpassed colored illustrations. The twelfth part of the third series is now announced as ready for distribution.

To turn for a few moments to our own affairs, I think I shall voice the feelings of you all when I say that we have much reason to congratulate ourselves on the progress and continued success of our Society, which is testified to in the reports of the council, and the treasurer and curator, which will presently be laid before you. It is well, however, for us all to remember that membership of a society carries with it the duty not only of paying the annual subscription to its funds, but also of giving some of our time and some of our work to furthering the special objects which it has in view. Much could no doubt be done by even the youngest and least skilled of our members by collecting specimens for our cabinets, making field observations on the habits of insects, or rearing them through their preparatory stages. Much remains to be learnt regarding the life history of many of our common butterflies, and there is still a boundless field to be surveyed among the moths and the other orders of insects. Short notes of original observations will always be of value and will be welcomed for publication by the editor of your journal, the *Canadian Entomologist*; he will also be pleased, especially at the present time, to receive contributions of an economic character for the pages of the annual report.

I beg to thank you, gentlemen, for your kind patience with me while I have attempted to lay before you those matters of entomological interest which have presented themselves to me during the past year. I am happy to feel that my somewhat meagre remarks will be well supplemented by those gentlemen who are to follow me with addresses to-night.

Mr. Fletcher moved a vote of thanks to the President for his admirable and entertaining address, and in doing so spoke of the increasing interest amongst farmers in the practical application of economic entomology for the prevention of insect injury. The Eye-spotted bud-moth had been prevalent over a very large area in North America this year, extending through Canada from the Maritime provinces to western Ontario. There were still varying opinions as to the manner in which the insect passed the winter. The peculiar flattened eggs are laid in July, and Dr. Lintner had reared one almost to its full size before the end of August. Prof. Fernald stated that he had bred them and that they passed the winter amongst the fallen leaves. He himself had found larvæ in New

Brunswick which he considered belonged to this species, which were in a sort of cocoon in the crevices of the gnarled fruit spurs of apple trees. He hoped members would try and settle the question for their own locality, as the decision as to this point is of great importance in deciding what is the best remedy to apply. He had secured good results in treating this insect as well as the leaf-rollers and canker-worms on apples by spraying early with Paris green. With regard to Cut-worms (*Agrotis ochrogaster*) the red-bellied cutworm had been complained of also by many of his correspondents. Several specimens had been sent to him from Lethbridge, a large proportion of which had proved to be parasitized. At Ottawa the species had also been abundant, and from rearing a large number he felt sure that the red form known as *Ag. turris* and the pale *ochrogaster* were the same species. Mr. Fyles had at the meeting a pair representing both forms taken in copulation. A new turnip pest had appeared in the Northwest Territories in the shape of a handsome chrysomelid named *Entomoscelis adonidis*. Several consignments were sent in during August.

Mr. J. Dearness had much pleasure in seconding the vote of thanks He quite agreed with the mover in the practical value of such an address as the President had given them. Speaking of the pea weevil, Mr. Dearness had heard from farmers in the school districts he had visited that this pest was not so prevalent as last year. With regard to the Eye-spot bud-moth, he suggested spraying both the ground and the twigs during the winter. He mentioned having recently noticed a number of webs or tents on trees.

The President in acknowledging the vote of thanks explained that the tent caterpillars in the spring and the fall web-worms are two distinct insects, and that while the latter is very abundant, the former is scarce.

Mr. Denton had noticed that the Clisiocampa referred to by the President as being conspicuous by its absence in most parts of the Province during the past season, was unusually abundant in some orchards about London ; he had collected no less than 103 nests in an orchard of three acres.

Capt. Geddes had also noticed the insect to be abundant in the state of New Jersey

Mr. Denton referred to the injuries of the pea-weevil, and pointed out the importance of making its habits and life history known so that farmers should take the proper precautions against sowing infested seeds.

Mr. Fletcher said that frequently many of the beetles left the peas in the autumn and hibernated about barns and similar places, and therefore seed should be treated with bisulphide of carbon as soon after harvesting as possible. This substance is so inflammable and dangerous that it could not be recommended for general use by farmers, but most of the large seed dealers who handled peas had a special house built for treating their seed peas. This was especially the case in Prince Edward County.

REPORT OF THE BOTANICAL SECTION.

The report of the Botanical Section was then read by the Secretary and adopted, as follows :—

During the past year this section has held regular weekly meetings through the spring, summer and early autumn months, as well as occasional meetings during the winter. The proceedings of these meetings have been a source of great profit and pleasure to all the members.

Under the leadership of Mr. Dearness the primary instruction of a year ago gave place to earnest work of a more advanced order.

A collection of native plants was begun, and there are now in the herbarium over three hundred species, all neatly arranged in a cabinet provided by the parent society. The success that has attended our work in this particular has been largely due to the

kindness of Mr. White, of Edmonton, and Mr. Morton, of Wingham, each of whom has furnished us with a large number of specimens; also to Mr. Balkwill, whose untiring energy has enabled us to have the plants arranged in their present orderly condition. The object of the section is to establish a reference collection in London, by which botanists in Western Ontario may be enabled to identify specimens.

Among the botanical *finds* of the year are twenty species of Phanerogams—not heretofore reported from this locality—four of them (viz., Buchnera Americana, Physalis Grandiflora, Acerates Viridiflora, and Isopyrum Bi-ternatum) being new to the Canadian flora as reported before. Besides these a very large number of rare plants have been brought in and examined.

Of mosses, our leader has discovered two new to Canada, while in the fungi Mr. Dearness has been able to add upwards of seventy species to the American list.

A floral calendar was kept from the united observations of the members, which we expect to be a source of interest for comparison with those of succeeding years.

During the year there were several very interesting outings participated in by the members of the section, the principal points visited being within a radius of a few miles. Profs. Bowman and Dearness and several of the other members explored the botanic treasures of the drowned lands of Huron and Middlesex, and the vicinity of Port Franks. These fields afforded several of the most notable of the recent additions to our herbarium.

We hope that the work so begun will be more actively and systematically carried on in the year to come, and we believe that the spirit and energy of the younger and newer members afford us a guarantee that such will be the case.

M. W. Althouse,
Secretary Botanical Section.

After the reading of the botanical report, upon invitation by the President, Prof. Bowman also spoke of the work of the section and expressed the view that the establishment of the different sections had been of great service to the parent society, having interested many students who were not specially devoted to the study of insects *per se.* He spoke also of the good service done by Mr. Dearness in naming and exhibiting specimens of fungi at the various meetings.

Dr. Woolverton reported upon the work of the Geological section.

CAN INSECTS SURVIVE FREEZING?

The President read the following paper by Mr. H. H. Lyman, of Montreal:—

In a foot note to his paper on "The Butterflies of Laggan" (Can. Ent. XXII. 129), Mr. Bean says, "I hope none of my younger readers entertain the absurd mediæval superstition that hibernating caterpillars pass the winter in a *frozen condition.* In successful hibernation they do not get near to such a condition; but if they do absolutely freeze, then are they undone caterpillars. Valkyria gives them sleep, unmixed with dreams, and they wake in Valhalla."

Without entering into any discussion as to my relative age in comparison with Mr. Bean's I may confess that I have long believed that some caterpillars as well as insects in other stages can and do survive freezing, and finding my belief so distinctly challenged, I have endeavoured to find some further light upon this subject from such literature as is accessible to me and from personal testimony. The first work to which I turned was Scudder's "Butterflies of New England."

In this work there is an Excursus, No. XVII, on "Lethargy in Caterpillars" and another, No. XXII., on "The Hibernation of Caterpillars," but in neither is any light thrown upon this question.

In the same author's "Butterflies" but little more is said upon this subject. On page 135, writing of Colias Philodice, he says "winter overtakes at once caterpillars of various ages, chrysalids and butterflies, and probably eggs. The experience of breeders, and the diversity in the time of appearance of the butterflies in the spring, render it probable that the cold season kills not only the butterflies and eggs, but perhaps the chrysalids as well, leaving the caterpillars to renew the life of the species in the spring." But though I have failed to gather from his works any information upon this subject I have learned from him personally and by letter some facts which may be thought to throw some light upon this question. About 35 years ago Mr. Scudder was prodding for beetles in some hole of a rotten stump in winter, at Williamstown, Mass., and came across several caterpillars of Isabella, and breaking at least one in two, found it brittle like an icicle and he believes he noticed crystals within, and therefore took two or three home to his room to see if they would come to life, which one or more did. Mr. Scudder, however, does not lay much weight on these facts and adds "I may or may not have broken more than one and do not at all remember whether only one or all came to life, but, of course, I *may* have broken only one and that one already dead."

I have recently seen somewhere, where I cannot now say, though I have spent hours in searching for the reference, an account of a caterpillar being found frozen into a cake of ice. The finder cut out a cube of the ice containing the caterpillar by means of a red hot poker, and then left the block on the sill outside his window for several days while the temperature ranged below zero. Upon bringing it into the house and thawing out the larva it revived and became quite active, but further experiment was prevented by its spinning its cocoon.

In Mr. Fletcher's report for 1889 (Experimental Farm Reports, 1889, p. 79) it is recorded that four larvæ of the Mediterranean Flour Moth (*Ephestia Kuhniella*, Zeller), were placed in a glass phial out of doors for half an hour when the temperature was only 5 degrees above zero F. and as a result were frozen hard so that they "rattled like glass beads against the sides of the bottle." Of the four, two never recovered at all, but the other two revived partially and retained their natural appearance for about a fortnight and moved their bodies a little though they finally succumbed. The Rev. T. W. Fyles has kindly given me the following particulars of his experience with larvæ of Coleoptera. "In the winter of 1864-5 I was splitting up decaying hemlock logs in my pasture at Iron Hill, P.Q., intending to burn them in the spring. On several occasions I found in these logs numbers of the larvæ of *Orthosoma unicolor* in a torpid state. In some cases the water had percolated into the burrows of the insects and frozen around their occupants. One day I picked out a number of the largest grubs from their icy envelopments and found them rigid and seemingly lifeless. I took them to my house and watched them as they slowly thawed into activity."

Dr. John Hamilton, of Allegheny, Pa., on the other hand, found, as related in his interesting paper in Can. Ent. XVII. 35, that he could not revive specimens of Coleoptera which were unquestionably frozen though some larvæ inclosed in cylinders of ice were still found to be flexible and regained activity on a rise of temperature. Though Dr. Hamilton's experience was decidedly against the theory that actual freezing does not necessarily cause death in insects he still admits that a good deal of evidence has been adduced on the other side and that records of the survival of frozen insects cannot be summarily dismissed.

To turn to some of the older writers on entomology I may quote the following from Kirby and Spence's "Introduction to Entomology," Vol. II., second edition. On page 231, after referring to some very extraordinary instances of the survival of insects under such trying circumstances as immersion in gin for 24 hours and immersion in boiling water, the authors say "Other insects are as remarkable for bearing any degree of cold. Some gnats that DeGeer observed, survived after the water in which they were was frozen into a solid

mass of ice, and Reaumur relates many similar instances." Later on, pages 452-3 of the same volume, in treating of hibernation of insects, I find the following very interesting remarks: "But though many larvæ and pupæ are able to resist a great degree of cold, when it increases to a certain extent they yield to its intensity and become solid masses of ice. In this state we should think it impossible that they should ever revive. That an animal whose juices, muscles and whole body have been subjected to a process which splits bombshells and converted into an icy mass that may be snapped asunder like a piece of glass, should ever recover its vital powers, seems at first view little less than a miracle, and if the reviviscency of the wheel animal (*Vorticella rotatoria*) and of snails, etc., after years of desiccation had not made us familiar with similar prodigies, might have been pronounced impossible, and it is probable that many insects when thus frozen never do revive. Of the fact, however, as to several species, there is no doubt. It was first noticed by Lister, who relates that he had found caterpillars so frozen that when dropped into a glass they clinked like stones, which nevertheless revived. Reaumur, indeed, repeated this experiment without success, and found that when the larvæ of *Bombyx Pityocampa*, F. were frozen into ice by a cold of 15° R. below zero (2° F. below zero) they could not be made to revive. But other trials have fully confirmed Lister's observations. My friend, Mr. Stickney, the author of a valuable "Essay on the Grub" (larva of *Tipula oleracea*) to ascertain the effect of cold in destroying this insect, exposed some of them to a severe frost, which congealed them into perfect masses of ice. When broken, their whole interior was found to be frozen. Yet several of these resumed their active powers. Bonnet had precisely the same result with the pupæ of *Papilio brassicæ*, which, by exposing to a frost of 14° R. below zero (0° F.), became lumps of ice and yet produced butterflies. Indeed, the circumstance that animals of a much more complex organization than insects, namely, serpents and fishes, have been known to revive after being frozen is sufficient to dispel any doubts on this head." In Burmeister's "Manual of Entomology" the above instances are also referred to though at much less length, but as no additional facts are adduced it is unnecessary to quote from his work.

The above would seem sufficient to establish the proposition that some insects can survive freezing, and indeed when one remembers that insects successfully maintain their existence in the most arctic lands which have ever been visited by man, it seems strange that any one should ever have questioned it. Is it conceivable that these tiny creatures, when in a state of lethargy and partaking of no nourishment, could successfully resist yielding to frost in regions subject to a temperature of over 70° F. below zero, and when in summer the soil only thaws to the depth of 12 or 15 inches, the ground below this depth being perpetually frozen?

The meteorological tables of the English Arctic Expedition of 1875-6 show that the mean temperature of the winter months at the stations of the two vessels, *Alert* and *Discovery*, varied from 5° F. below zero in October and 17° F. below zero in April to 40° F. below zero in the middle of the winter, and that the minimum temperatures recorded were:—73¾° F. at the winter quarters of the first named vessel, and—70·8° F. at the station of the latter in Discovery Bay.

In spite of these terrible temperatures the naturalists attached to the expedition were very successful, and Mr. Robert McLachlan, F.R.S., to whom the collections of insects were submitted, wrote as follows in his report:

"The materials brought home from between the parallels 78° and 83° N. latitude, showed quite unexpected, and, in some respects, astonishing results. I have no hesitation in saying that the most valuable of all the zoological collections are those belonging to the entomological section, because these latter prove the existence of a comparatively rich insect fauna, and even of several species of showy butterflies, in very high latitudes."

But the most interesting account of experiments on this subject which I have seen, is that given by Commander James Ross, R.N., F.R.S., and inserted by Curtis in the Entomological Appendix to the "Narrative" of Sir John Ross's second arctic voyage. The

experiments were tried upon the caterpillars of *Laria Rossii*, a very abundant species in Boothia Felix, and, doubtless, all through the arctic regions of this continent. The account (page lxxi.) is as follows :

"About thirty of the caterpillars were put into a box in the middle of September, and after being exposed to the severe winter temperature of the next three months, they were brought into a warm cabin, where, in less than two hours, every one of them returned to life, and continued for a whole day walking about. They were again exposed to the air at a temperature of about 40° below zero, and became immediately hard frozen ; in this state they remained a week, and on being brought again into the cabin, only twenty-three came to life. These were at the end of four hours put out once more into the air, and again hard frozen ; after another week they were brought in, when only eleven were restored to life. A fourth time they were exposed to the winter temperature, and only two returned to life on being again brought into the cabin. These two survived the winter, and in May an imperfect *Laria* was produced from one, and six flies from the other."

That a caterpillar infested with parasites should have been able to survive such severe treatment and spin its cocoon is most remarkable, and it is not to be wondered at that alternate freezing and thawing should have been disastrous to the majority of those experimented upon.

Many other similar accounts doubtless exist, but I think that the records which I have thus brought together are sufficient to prove that actual freezing is not necessarily fatal to insects, and that Mr. Bean had no sufficient warrant for the statement quoted at the beginning of this article.

Mr. Dearness was of the opinion that it was clearly the thawing not the freezing of plants which caused the injury.

Mr. Fletcher asked him whether he did not think that the rupturing of cells and tissues by the crystallization and expansion of the contained liquids was the chief injury.

Mr. Dearness thought not, because if care were taken in thawing out frozen plants slowly many of them would sustain little injury. He recounted the experience of a friend who had endeavoured to get very early potatoes by planting them before the usual time. After they were well above the ground a severe frost occurred. He went out very early in the morning and watered a part of them with cold water ; these were all killed, whilst others under a fence were uninjured. He accounted for this from the fact that at the time he watered the plants the temperature of the air was below the freezing point, and as soon as the water fell upon the plants they were temporarily thawed out and then froze up again, and were scorched by the sun as soon as it fell upon them. Geranium slips, he said, could be buried beneath the surface of the ground and would receive no injury if the thawing were gradual.

Prof. Bowman thought that insects were better able to withstand freezing in some stages of their growth than in others. Dallinger had found in his investigations of bacteria, that a kind of bacterium which could, at a certain stage of its development, withstand the effect of boiling water, would at others be easily destroyed. He thought that the woolly covering of plants and insects, as well as the cocoons of the latter, were intended to protect them from the effects of too rapid changes of temperature.

Mr. Harrington gave a most interesting account of a trip to Japan, which he illustrated with a number of beautiful and remarkable specimens.

Mr. Fletcher gave a very interesting account of a visit he made in August last to Mr. W. H. Edwards, the celebrated author of the great work on "The Butterflies of North America," who lives at Coalburgh, in West Virginia. He was especially interested in the methods of breeding butterflies through all their stages from the egg to the imago. Among many valuable points that he referred to, there may be mentioned that when eggs are placed in a glass bottle preparatory to hatching, it is best to use a tight plug of cotton batting rather than a cork ; when the insects hatch out they usually do not require any food for twenty-four hours ; it is best to have a plant of the required kind growing in a

pot if possible, and transfer the young caterpillars to it, keeping the whole covered with gauze ; a small plant may be kept under a glass lamp chimney with gauze pasted over the top ; the larvæ will wander about if the plant is not the usual food-plant of the species, but they can usually be got to eat an allied plant of the same botanical genus. When the working table is covered with twenty or thirty breeding jars it is well to have a conspicuous coloured label for those that require frequent or regular attention. Bags for enclosing larvæ feeding on plants out-of-doors should be very neatly made, in order that there may be no corners for the insects to hide in. It is very important that the breeding-jars or cages should be kept scrupulously clean. Among the butterflies he saw at Coalburgh there may be especially mentioned *Argynnis Diana*, which was first found in the mountains near by ; *Argynnis Cybele*, remarkable for the large size of the specimens ; *Papilio Philenor*, *Debis Portlandia*, of which there are two broods in the year, etc. Single Zinnias were found to be most attractive to butterflies of all kinds, and should be freely planted in the collector's garden.

The next paper on the list was read by the Rev. T. W. Fyles on *Nematus Erichsonii*, the larch saw-fly, which has become so excessively destructive in the lower Province during the last few years.

The meeting adjourned at 10.45 p.m.

THURSDAY MORNING.

The Society met again in their rooms at 10.15 a.m. An interesting letter was read by Mr. Fletcher from Mr. Edmund Baynes Reid, who is now in charge of the Government Meteorological Station at Esquimalt, British Columbia.

Capt. Geddes read a paper on his recent visit to Germany and the entomologists whom he had met there.

Mr. Harrington described a method of packing beetles and other insects for transportation in rolls of paper, which he had found very simple and effective. Mr. Fletcher mentioned the capture at Ottawa of the rare Southern moth, *Erebus odora*. Mr. Fyles read a paper on the larvæ of *Gelechia gallœ-diplopappi* and a parasite which he had procured from it, and exhibited coloured drawings in illustration. The paper will be published in the *Canadian Entomologist*. Mr. Harrington said that the parasite was evidently, as Mr. Fyles said, a *Bracon*, but that the genus was a difficult one, and it was hard to say whether it was a new species or not.

Capt. Geddes exhibited a specimen of *Melitœa Carlota* taken at Scarborough, near Toronto. Mr. Fletcher exhibited a specimen of *Pyrgus centaureœ*, taken at Wabigon tank on the Canadian Pacific Railway, by Mr. W. McInnes, of the Geological survey, and one of *P. cœspitalis*, which resembles it very closely, from British Columbia, where it is not uncommon.

Mr. Moffatt read a letter from Miss Emily Morton, of Newburgh, N.Y., in which she described her experiences in rearing hybrids of the large Emperor moths, some of which remained for twenty-three months in their cocoons, and related her chief captures during the season, especially referring to her success in collecting at willow catkins last April.

Mr. Moffatt also read his paper on the results of his examination under the microscope of an unexpanded wing of *Callosamia promethea*.

Mr. Fletcher drew the attention of the meeting to specimens which he exhibited of (1) *Argytes longulus*, Lec., a rare Sylphid taken on Vancouver Island by Prof. John Macoun in 1887 ; (2) *Entomoscelis adonides*, a showy red and black chrysomelid which has occurred as a pest to turnips and cabbages in the Northwest territories during the past season ; (3) *Acronycta funeralis*, bred from white birch at Ottawa ; (4) *Gortyna cataphracta*, which is a troublesome pest in gardens, boring into the stems of tomatoes, lilies, and raspberries ; and a single specimen which had entered the stem of a grass, *Elymus Canadensis*; (5) *Myrmeleon abdominalis*, bred from larvæ collected near Indianapolis, Indiana, and exhibited at the last annual meeting.

The meeting, which was throughout very enjoyable and successful, then adjourned.

NOTE ON LIFE AREAS.

With regard to the distribution of birds, ornithologists have hitherto accepted as approximately correct the faunal areas as defined by Prof. J. A. Allen, of New York. By him the breeding areas of certain birds were considered to fall within the limits of one or more of these faunæ. For instance the Slate-colored Junco (*Junco hyemalis*) was held, during the period of reproduction, to be limited in its southward dispersion by the Canadian fauna ; the Wood Thrush (*Turdus mustelinus*) by the Alleghanian, and the Cerulean Warbler (*Dendroisca cœrulea*) by the Carolinian.

The mean summer temperature being considered the most important factor in determining these divisions, latitude had less to do with the question than altitude. For instance, mountain tops in low latitudes were correctly held to be isolated portions of the Arctic fauna. But Middlesex is uniform in its physical features, and yet representatives of the three faunæ given above have been found breeding in the county under almost identical climatic conditions. Deep, cool swamps occur, which may account in part for the presence of the more northern species, but on the whole there is such an abnormal admixture of birds usually found in summer so far apart as to throw doubts on the feasibility of maintaining such divisions. It is probable that the researches of Prof. Merriam, Ornithologist for the Department of Agriculture at Washington, who has lately given much attention to the problem of distribution, will prove that there are but two life provinces in North America, viz:—The Boreal (Northern), and the Sonoran (Southern) according as the forms of life inhabiting each have reached this continent from the north or south. When the limits of these two great divisions are mapped out it will likely be found that Middlesex occupies a neutral position, being on the whole Sonoran rather than Boreal, but with a strong tinge of the latter.

LIST OF BIRDS KNOWN TO BREED IN MIDDLESEX COUNTY, ONTARIO.

BY THE LONDON ORNITHOLOGICAL SECTION OF THE ENTOMOLOGICAL SOCIETY.

Those birds which are decidedly and directly beneficial on account of their feeding habits are marked (*a*). Those which are neutral or nearly so are marked (*b*). Those which are open to doubt as being possibly injurious are marked (*c*).

(*b*) AIX SPONSA — *Wood Duck.*—Residents around the pond at Dorchester say it bred there up to about five years ago.

(*b*) BOTANRUS LENTIGINOSUS—*Bittern*—A nest of unfledged young found on the flats at Arva in 1889, by W. A. Balkwill.

(*b*) ARDEA HERODIAS—*Great Blue Heron*—A few heronries containing sometimes as many as several hundred nests are known in the county, though they are becoming gradually deserted. Occasionally single nests are found in high deciduous woods.

(*b*) ARDEA VIRESCENS—*Green Heron*—One nest found within two miles of the city in 1888 by W. A. Balkwill. Pairs are believed to breed in other parts of the county, having been seen regularly in summer.

(*b*) PHILOHELA MINOR—*American Woodcock*—Not very common.

(*b*) ACTITIS MACULARIUS—*Spotted Sandpiper*—Breeds commonly in fields and waste places near water.

(*a*) ÆGIALITIS VOCIFERA—*Kildeer Plover*—Not very common, perhaps one pair to a square mile.

(*b*) COLINUS VIRGINIANUS—*Bob-white*—Abundant in the west and south, but quite rare in the north-east of the county.

(*b*) Bonasa umbellus—*Ruffed Grouse*—Common in most large or thick woods at a reasonable distance from the towns.

(*b*) Meleagris gallopavo—*Wild Turkey*—Formerly quite common. A nest was found in Delaware Township in 1878 with thirteen eggs.

(*b*) Zenaidura macroura—*Mourning Dove*—Not as common in Middlesex as it is farther west in the peninsula.

(*a*) Cathartes aura—*Turkey Vulture*—A nest was found in 1890 by J. N. Sullivan near Kerwood. Several other pairs probably breed in the county.

(*a*) Circus hudsonius—*Marsh Hawk*—Breeds in almost all large sphagnum swamps, also in fields occasionally ; one nest found in London South in June, 1890.

(*c*) Accipiter velox—*Sharp-shinned Hawk*—Three nests only are recorded ; not many pairs spend the summer here.

(*c*) Accipiter cooperi—*Cooper's Hawk*—Breeds sparingly.

(*a*) Buteo borealis—*Red-tailed Hawk*—Tolerably common.

(*a*) Buteo lineatus—*Red-tailed Hawk*—Our most common hawk in the breeding season.

(*a*) Falco sparverius—*American Sparrow Hawk*—Rather rare. Probably not more than one pair in three or four square miles.

(*a*) Asio wilsonianus—*American Long-eared Owl*—Only one nest found, by R.Elliott near Plover Mills.

(*a*) Megascops asio—*Screech Owl*—Not uncommon, though nests are not often found. One by W. A. Balkwill near London in 1890, and 1891 in the same hole.

(*a*) Bubo virginianus—*Great Horned Owl*—Tolerably common.

(*a*) Coccyzus americanus—*Yellow-billed Cuckoo*—More common than the next, laying smaller sets of larger eggs. Believed to have increased in abundance during the last ten years.

(*a*) Coccyzus erythrophthalmus—*Black-billed Cuckoo*—Contrary to its custom elsewhere, nests have been found with six eggs. Sets of this size in other parts of the country have generally been reported as being partly hatched, the eggs being laid at considerable intervals so that the first eggs are hatched before the last are laid.

(*b*) Ceryle alcyon—*Kingfisher*—Common.

(*a*) Dryobates villosus—*Hairy Woodpecker*—Rather rare ; nests usually escape detection until the young are hatched.

(*a*) Dryobates pubescens—*Downy Woodpecker*—More common than the last.

(*a*) Sphyrapicus varius—*Yellow-bellied Woodpecker*—Rare.

(*a*) Ceophlœus pileatus—*Pileated Woodpecker*—Very rare.

(*a*) Melanerpes erythrocephalus—*Red-headed Woodpecker*—Common.

(*a*) Melanerpes carolinus—*Red-bellied Woodpecker*—Very rare.

(*a*) Colaptes auratus—*Flicker*—Common. Holes made by this species and by the Red-head are occasionally found so close to the ground that the eggs are almost on the ground level.

(*a*) Antrostomus vociferus—*Whip-poor-will*—Tolerably common in suitable localities. Appears to be less common this year than formerly.

(*a*) Chordeiles virginianus—*Night Hawk*—Common.

(*a*) Chaetura pelagica—*Swift*—Common. Still breeds in trees occasionally.

(*a*) Trochilus colubris—*Ruby-throated Hummingbird*—Rather rare.

(*a*) Tyrannus tyrannus—*Kingbird*—Common.

(*a*) Myiarchus crinitus—*Crested Flycatcher*—Tolerably common.

(*a*) Sayornis phœbe—*Phœbe*—Common. Most suitable bridges contain one pair, and nests are also built in the upturned roots of trees in the woods.

(*a*) Contopus virens—*Wood Pewee*—Common.

(*a*) Empidonax minimus—*Least Flycatcher*—Common.

(*a*) Otocoris alpestris praticola—*Prairie Horned Lark*—Common.

(*c*) Cyanocitta cristata—*Blue Jay*—Tolerably common.

(*c*) Corvis americanus—*Crow*—Common.

(*a*) Dolichonyx oryzivorus—*Bobolink*—Common.

(*c*) Molothrus ater—*Cowbird*—Very Common.

(*a*) Agelaius phœniceus—*Red-winged Blackbird*—Common.

(*a*) Sturnella magna—*Meadow Lark*—Common.

(*a*) Icterus galbula—*Baltimore Oriole*—Common.

(*c*) Quiscalus quiscala æneus—*Bronzed Grackle*—Common.

(*c*) Carpodacus purpureus—*Purple Finch*—Uncommon.

(*b*) Acanthis linaria—*Redpoll*—A single nest found near Hyde Park by J.A.Morden in 1879. Birds not seen, but eggs identified by comparison with European specimens from the same species.

(*a*) Spinus tristis—*American Goldfinch*—Common—Spotted eggs have been found on rare occasions.

(*a*) Poocætes gramineus—*Vesper Sparrow*—Very Common.

(*a*) Ammodramus sandwichensis savanna—*Savanna Sparrow*—Common.

(*a*) Chondestes grammacus—*Lark Finch*—Rare. A single nest found in 1890 a few miles west of the city.

(*a*) Spizella socialis—*Chipping Sparrow*—Common.

(*a*) Spizella pusilla—*Field Sparrow*—Common in certain localities.

(*a*) Junco hyemalis—*Slate-colored Junco*—Common in certain localities, particularly so in the north-eastern part of the country.

(*a*) Melospiza fasciata—*Song Sparrow*—Very common.

(*a*) Melospiza georgiana—*Swamp Sparrow*—Common in marshy places, but only one nest found, by R. Elliott.

(*a*) Pipilo erythrophthalmus—*Towhee*—Common.

(*a*) Habia ludoviciana—*Rose-breasted Grosbeak*—Appears to be less common than formerly.

(*a*) Passerina cyanea—*Indigo Bunting*—Tolerably common.

(*a*) Piranga erythromelas—*Scarlet Tanager*—Tolerably common.

(*a*) Progne subis—*Purple Martin*—Much less common than formerly. This species has suffered by the pre-occupation of its breeding places by the English sparrow.

(*a*) Petrochelidon lunifrons—*Cliff Swallow*—Less common than formerly, owing to the same cause, somewhat, as the former species.

(*a*) Chelidon erythrogaster—*Barn Swallow*—Common.

(*a*) Tachycineta bicolor—*Tree Swallow*—Tolerably common.

(*a*) Clivicola riparia—*Bank Swallow*—Common in suitable localities, although not so common as formerly.

(*a*) Stelgidopteryx serripennis—*Rough-winged Swallow*—Uncommon.

(*a*) Ampelis cedrorum—*Cedar Waxwing*—Tolerably common.

(*a*) Lanius ludovicianus excubitorides—*White-rumped Shrike*—Rare.

(*a*) VIREO OLIVACEUS—*Red-eyed Vireo*—Common.

(*a*) " GILVUS—*Warbling Vireo*—Rather common.

(*a*) " FLAVIFRONS—*Yellow-throated Vireo*—Rare.

(*a*) MINIOTILTA VARIA—*Black and White Warbler*—Common in deep woods, but only one nest found, by W. E. Saunders in May, 1881.

(*a*) HELMINTHOPHILA CHRYSOPTERA—*Golden-winged Warbler*—Rather rare.

(*a*) " RUFICAPILLA—*Nashville Warbler*—Limited to a few localities; a single nest found by Wm. Saunders near London in 1882.

(*a*) DENDROICA ÆSTIVA—*Yellow Warbler*—Common.

(*a*) " PENNSYLVANICUS—*Chestnut-sided Warbler*—Tolerably common.

(*a*) SEIURUS AUROCAPILLUS—*Ovenbird*—Tolerably common.

(*a*) " NOVEBORACENCIS—*Water Thrush*—Rather rare.

(*a*) GEOTHLYPIS TRICHAS—*Maryland Yellow Throat*—Common in suitable localities.

(*a*) SYLVANIA CANADENSIS—*Canadian Warbler*—Rather common. Partially fledged young found in several localities near London.

(*a*) SETOPHAGA RUTICILLA—*Redstart*—Common.

(*a*) GALEOSCOPTES CAROLINENSIS—*Catbird*—Common.

(*a*) HARPORHYNCHUS RUFUS—*Brown Thrasher*—Locally common.

(*a*) TROGLODYTES AEDON—*House Wren*—Common.

(*a*) TROGLODYTES HIEMALIS—*Winter Wren*—A single nest found with one egg; not uncommon in deep cedar-swamps.

(*a*) CERTHIA FAMILIARIS AMERICANA—*Brown Creeper*—Rare. A nest of young found nine miles from London in June, 1880.

(*a*) SITTA CAROLINENSIS—*White-breasted Nuthatch*—Not very common.

(*a*) PARUS ATRICAPILLUS—*Black-capped Chickadee*—Not common.

(*a*) POLIOPTILA CERULEA—*Blue-gray Gnatcatcher*—Tolerably common.

(*a*) TURDUS MUSTELINUS—*Wood Thrush*—Tolerably common.

(*a*) " FUSCESCENS—*Wilson's Thrush*—Common.

(*a*) MERULA MIGRATORIA—*Robin*—Abundant.

(*a*) SIALIA SIALIS—*Blue Bird*—Common. A few sets of white eggs have been found.

SUPPLEMENTARY LIST—NO. 1.

Birds which have probably bred in greater or less numbers in the past, but have now become so rare that it is unlikely that their nests will be found:

(*b*) LOPHODYTES CUCULLATUS—*Hooded Merganser.*

(*b*) ECTOPISTES MIGRATORIUS—*Passenger Pigeon.*

SUPPLEMENTARY LIST—NO. 2.

Birds which are observed in summer and are likely to be found breeding as the fauna is better worked up:

(*a*) RALLUS VIRGINIANUS—*Virginia Rail.*
(*a*) PORZANA CAROLINA—*Carolina Rail.*
(*a*) GALLINULA GALEATA—*Florida Gallinule.*
} Will probably be found in some of our larger marshes.

(*a*) SYRNIUM NEBULOSUM—*Barred Owl*—Scarce resident.

(*a*) Nyctala acadica—*Saw-whet Owl*—Young have been taken near St. Thomas, in Elgin County, in July.

(*a*) Empidonax pusillus traillii—*Traill's Flycatcher*—Frequently observed in May and June.

(*a*) Contopus borealis—*Olive-sided Flycatcher*—One observed June 2nd, 1891. Common summer resident in Bruce County.

(*a*) Icterus spurius—*Orchard Oriole*—Common in parts of adjoining counties, and observed every spring.

(*a*) Zonotrichia albicollis—*White-throated Sparrow*—Observed at different points in summer.

(*a*) Dendroica caerulescens—*Black-throated Blue Warbler.*
(*a*) " caerulea—*Blue Warbler.*
(*a*) " blackburniæ—*Blackburnian Warbler.*
(*a*) " virens—*Black-throated Green Warbler.*
(*a*) " vigorsii—*Pine Warbler.*
(*a*) Geothlypis philadelphia—*Mourning Warbler.*

Frequently observed in May, June, and July.

(*a*) Cistothorus palustris—*Long-billed Marsh Wren*—Nests will likely be found in some of our larger marshes.

(*a*) Regulus satrapa—*Golden Crowned Kinglet*—Has been observed twice in June in the spruce swamp near London.

(*a*) Turdus aonalashkae pallasii—*Hermit Thrush*—Heard singing in June in cedar swamps.

PAMPHILA MANITOBA (SCUD.) AND ITS VARIETIES.

BY H. H. LYMAN, MONTREAL.

In 1874, Mr. Scudder published his paper on "The Species of the Lepidopterous Genus Pamphila," in the Memoirs of the Boston Society of Natural History, in which the following species were described as new: Nevada, Colorado and Manitoba; and Sassacus, Ottoe, Juba, Comma of Europe, and Sylvanoides were also treated of.

None of the descriptions are detailed, but are altogether comparative pointing out the differences between the closely allied forms, and in the case of Manitoba, the comparisons instituted are exclusively with the European Comma. The four specimens (two males and two females illustrated) are all from the west of the continent, or rather, I should say, from the west and centre. One specimen was from Lake Winnipeg, one from Colorado, and two from British Columbia. The figures show specimens of which the underside of secondaries is dark greenish or greenish brown, and with considerable variation in the prominence or restriction of the markings.

Though no figure of any eastern specimen is given, it is stated in the text that the species had been taken at Riviere du Loup by Mr. Couper.

Since then it has been repeatedly taken on the Lower St. Lawrence by other collectors at Cacouna and Riviere du Loup, Metis, and even as far as Gaspe by myself, in 1888.

The form found on the Lower St. Lawrence is very uniform in colour and has the outer third of the underside of the fore wings and the whole of the underside of the hind wings, with the exception of the inner margin and hind angle, of dark brown colour, though occasionally with a slightly greenish tinge.

In 1890, on returning east from a trip over the Canadian Pacific Railway, I stopped for a day at Regina, the date of my visit being Aug. 5th, and as usual devoted a good

part of the day to collecting lepidoptera. Among other things I collected a good series of males of a Pamphila of the Manitoba group which was new to me, but only succeeded in securing one female, it apparently being a little early for that sex. During October of that year I paid a flying visit to New York and Boston taking a few specimens with me for comparison, among them a specimen of this skipper which I showed to Mr. Henry Edwards, who said that he did not know it and thought it must be new. Mr. Scudder said it might be new, but one needed a very full series in that group. I afterwards showed it to Mr. Fletcher and asked him if he had ever seen that form and he immediately said "Yes, at Regina." He added that he had sent a specimen to Dr. Henry Skinner who had pronounced it to be only Manitoba, but Mr. Fletcher expressed to me the opinion that it was at least a very distinct variety. The point in which this form chiefly differs from Manitoba of the Lower St. Lawrence is that those parts on the underside which are brown in the latter are of a very pale greenish yellow or yellowish green in the Regina form, but it also differs somewhat above in that the males are usually of a yellower tone while the brown of the female is decidedly darker and the spots of the fore wing decidedly lighter, some of them being almost white, than in the eastern specimens.

Wishing to get further light upon the probable relationship of these forms, I this year took a number of specimens of each with me on a trip to Boston and New York before returning home from a short holiday on the Atlantic coast, and through the kindness of Mr. Scudder was enabled to examine his original types of Manitoba. One of these agreed exactly with my specimens from the Lower St. Lawrence, while the ones from British Columbia and Colorado were greener, but none agreed with, or even approached the average of the Regina specimens. Mr. Scudder, however, on account of the close similarity of the markings seemed to be of opinion that the Regina form must be a variety of Manitoba. At New York Mr. Neumoegen kindly allowed me to compare my specimens carefully with the Pamphilas in his magnificent collection, but no specimen was found which at all agreed with the Regina form, and Mr. Neumoegen expressed the opinion that I would be safe in describing it. But in order to guard against all danger of being accused of rashness I took the specimens out to New Brunswick, N. J., to Prof. J. B. Smith, who very kindly at my request dissected the male abdominal appendages of one of the Regina specimens, which upon examination were seen to be practically identical with the illustrations of those of Manitoba drawn by the late Mr. Edward Burgess and published by Mr. Scudder. The form would therefore seem to be only a variety of Manitoba, but Prof. Smith expressed the opinion that it might very properly receive a varietal name as a distinct geographical race. Mr. Scudder, however, in his "Butterflies of New England" would seem to have adopted this form as a basis of his description of Manitoba, as he describes the underside of the hind wings as being, except for the markings, "almost uniformly greenish yellow," although he has no specimen of the Regina form in his collection.

I am, however, strongly of opinion that the difference between the eastern specimens and these from Regina is sufficiently great to be worthy of being indicated by varietal names, and if the name Manitoba is to be restricted to the dark brown or greenish brown specimens, as I believe it was originally applied, I would suggest the name, var. Assiniboia, for the light greenish-yellow Regina form. If, however it is preferred to call the latter Manitoba I should suggest the name, var. Laurentina, for the dark brown form of the Lower St. Lawrence.

NEMATUS ERICHSONII: A RETROSPECT.

BY REV. THOMAS W. FYLES, SOUTH QUEBEC.

The fecundity and voracity of this species must have arrested the attention of foresters and entomologists at a very early date after its introduction to America. It is believed to have been brought over on *Larix Europœa*, and its operations were first noticed in 1880, by Professor C. S. Sargent, Director of the Arnold Arboretum at Brook-

line, Massachusetts.* In 1881 and 1882 it came under the notice of Dr. Packard in the State of Maine; and in 1883 I observed it in vast numbers in the border townships of Bury and Lingwick in the Province of Quebec, and drew the attention of the Entomological Society of Ontario to the fact. Early in the summer of the following year I witnessed a flight of the perfect insects at Quebec, and gathered a number of the exhausted flies from the decks of the ferry-boats plying between Levis and that city. In that same year the tamaracks around my residence were completely defoliated by the larvæ. It was impossible to approach the trees with comfort. The creatures were crawling everywhere around; and the sound produced by the droppings of their excrementa upon the undergrowth was like an incessant pattering of rain-drops. By this time their ravages had been traced through the length of eastern Canada and into the maritime Provinces.

It was at first thought that the tamarack would survive the assaults of the Nematus—the more because a second growth of verdure appeared on the trees after the larvæ had left them. So eminent an observer as Dr. Packard was inclined to this opinion;† but Professor Riley seems to have had a clearer view of the consequences of the insect's attacks.‡

Many entomologists watched the Nematus through its metamorphoses hoping to discover parasitic foes of the insect. I have not learned that any were successful. The European parasites of the species (if such there were) did not appear; and our native Hymenoptera parasitica had not, it would seem, acquired a taste for the immigrant. Predacious insects, ants,§ and ground beetles, || were found to prey upon it, but their attacks made but little impression upon the hordes of the invaders. This was owing probably to the fact that swamps, in which the tamarack abounds, are but ill suited for the abodes of ants and ground beetles.

The pest was clearly beyond human control. Ornamental trees around dwellings or in parks might, it was thought, be saved by "spraying," but beyond this nothing could be attempted.

The appearances, the life history, the operations of *Nematus Erichsonii* have all been minutely described; and allusions have often been made to the destruction wrought by the insect in Canada, but on this last point but little definite information has been given. With a view to arriving at something more precise in regard to it, I, a few weeks ago, made a visit to the townships in which I had first seen the insect, and in Bury I met by appointment the Rev. R. H. S. Fuller, rector of Bury, Mr. John B. Maddocks, superintendent of lumbermen, and Mr. Robert Clark, one of the leading farmers in that section. From conversations with these gentlemen, and from personal observation, I was able to gather the following particulars.

The tamarack swamps of the Township of Bury occupy about one tenth of its surface, or 640 acres, and show on an average forty marketable trees to the acre. The largest of these trees are about 2 feet 6 inches in diameter at the butt—one was found having a diameter of 2 feet 9 inches. The usual size is 2 feet. This represents a growth of 200 years. Two hundred and twenty rings of annual growth was the actual record on the butt of one tree. Besides these marketable trees there are numerous others, in every stage of growth, which, under favourable circumstances, would, in successive years, have attained to marketable value. Of all these trees 98 per cent. are dead and the remainder dying.

Of the Township of Lingwick one-fifth, it is computed, is tamarack swamp. There is of such swamp one tract, lying partly in Lingwick and partly in Weedon, that is said to be five miles square. The destruction wrought in all this section is proportionate to that in Bury.

The tamarack as a shade tree is less valued than the pine, spruce, balsam and cedar, for the reason that its foliage is deciduous; but in the summer season when grown in the

*Dr. Lintner, 5th Report on the injurious and other insects of the State of New York, p 22.

†18th Ann. Rep. Ent. Soc. of Ont. p. 32

‡Ibid.

§18th Ann. Rep. Ent. Soc. of Ont. p. 32.

|| Rep. of Proceedings of the Convention of fruit growers held at Ottawa, 1890, p. 69.

open, or the arboretum, it is a peculiarly graceful and beautiful object. For a short period also, in the autumn, when it has assumed its golden dress, it presents a pleasing contrast to the evergreens above named. Its wood, however, is valuable for many purposes. It is close-grained and firm, and resists the action of moisture, and, on these accounts, is prized for sleepers in buildings, railway-ties, and for fence-posts. As fire-wood, it is worth in the towns about $3 per cord. But the chief value of tamarack is for the purposes of the ship-builder.

From the swamps of Bury the knees and other timbers have been cut for vessels ranging from barges of thirty tons to brigs of 400 tons burden. The firm that is operating in this section of country is that of Benjamin, Lewis & Company, of Bangor, Maine. One million feet, board measure, will, by the close of the season, have been cut by them in the present year, in the Township of Bury alone I shall base my estimate of the loss sustained by the township through the saw-fly, upon the operations of this firm.

In former days when the timber was sound, $3 per 1000 feet on the stump, board measure, was paid for it. Now, through waste and general deterioration, the trees are worth only one-half their former price. Sap-rot commences very soon after the death of the tree, and by the second year has proceeded to a very sensible extent. Various kinds of "borers" then make their assaults, and penetrate the heart wood, hastening the decay of the tree. It is believed that in three years, through use and decay, the supply of tamarack throughout the country will be exhausted.

The borers that I found at work in the tamarack were larvæ belonging to the families Buprestidæ, Cerambycidæ and Elateridæ. I also found one or two cocoons of a Hymenopterous insect.

As we have seen, there are in Bury 640 acres of tamarack giving on the average forty marketable trees to the acre, or 25,600 such trees in all. Every tree contains at least 400 feet, board measure, of lumber. This gives for the whole forest 10,240,000 feet, which, in a sound condition, would have been worth $30,720, and which left standing would, under favourable circumstances, have been increasing in value. On the 1,000,000 feet that will have been secured by the end of the season, there will be a direct and immediate loss of $1,500. Supposing, which is hardly probable, that 1,000,000 feet at the same price will be cut next year, there will yet be 8,240,00 feet of lumber, representing $24,720 in money value entirely lost to the township, besides the value of the younger trees which would have been a source of income in future years, as they successively attained perfection.

The tamarack forest of the townships is a thing of the past. There seems to be a law of nature, that, when one growth of trees is swept away, another of a different kind shall succeed it. The hemlocks and pines of our mountain sides give place to the poplar and the white birch. The tamaracks will propably be succeeded by the American arbor-vitæ or white cedar (*Thuja occidentalis*). And, if there were no such natural law, the world is too old, its population too vast, and land in the temperate regions too valuable, for us to suppose that large tracts of lowlands will be left in a state of nature for 200 years to come.

The value of the Canadian tamarack was only beginning to be understood in the foreign market. The demands for it were increasing, and with increased demands better prices would have come. All things considered, I do not think it an exaggeration to say that the loss to the Township of Bury alone, through the attacks of *Nematus Erichsonii* may be estimated at $50,000, and that of Lingwick at double that sum. And when we consider that the ravages of the insect have extended through the townships, and the seigniories,* and into the country beyond to its utmost known limits, we are brought to the conclusion that *Nematus Erichsonii* has been the worst insect pest that has ever visited the Province of Quebec. It has acquired the "bad eminence" of a position in the rank of infamy above the midge, the weevil, the potato-beetle, and the army-worm.

With its food-plant the insect must of necessity disappear, and in years to come the specimens preserved in our cabinets will be regarded as rarities.

*In the Seigniory of Lotbiniere alone there are 100,000 acres producing more or less tamarack to the acre.

ON SOME OF THE COLLECTIONS IN ENGLAND AND THE GERMAN EMPIRE.

BY GAMBLE GEDDES, TORONTO.

It gives me great pleasure, Mr. President and gentlemen, to read to you some notes upon the collections I had the privilege of examining during a stay of some months on the continent and three weeks in London, England, when returning to Canada.

Crossing from Hoboken, N.J., by the German Lloyd S. S. Aller, the first entomologist I visited upon landing at Bremen in Germany was our old friend and collaborator Aug. R. Grote, and busy as he was about other matters in general, but music in particular, he found time to take me to see Mr. Lahmann's breeding room, where I saw a large number of the larvæ of Europe feeding, and also hundreds of pupæ ready for shipping to different parts of the world. In this collection I saw principally the Arctiadæ and Bombycidæ, but likewise many Papilios—and it was a matter of wonder to me, to see how Mr. Lahmann kept alive the food-plants for these larvæ in such a dark room as he kept them in. For the benefit of the members of the Society who might like to correspond with Mr. Lahmann, I may state that he is always ready to exchange for N. and S. American species, those of Europe, and he has succeeded in breeding many rarities in large numbers. His address is, Albert Lahmann (Ambrill Strasse 8) Bremen, Germany.

My next visit was to Dr. Meyer, director of the Natural History Museum at Dresden. Professor Ramsay Wright having furnished me with a letter of introduction, Dr. Meyer immediately put me in the hands of Dr. Heller the entomologist of the Institution, who was most attentive to my wants, and during my several visits to the collection, always managed to spend a portion of his time with me and placed the cabinets and library at my disposal whenever I desired to refer to them. Here I first observed the drawers made with glass at top and bottom, with only thin strips of cork fastened in to pin the specimens to. Any collector who has not already seen these drawers can readily appreciate the use of them. Instead of mounting Lepidoptera showing the upper and under surfaces, it is only necessary to set them right side up, and in order to examine the under-sides, all one has to do, is to turn the drawers up-side-down when the reverse sides can be examined through the glass, thus saving space and time.

This collection is well worth a visit from any traveller for it embraces fine representations in all classes of insects from every part of the globe. A number of collections have been donated to this museum by private individuals, and many purchases have been made. The whole lot have been carefully selected from and the best specimens consolidated into a fine collection of reference not only for the entomological students of Germany but for foreigners wishing to consult the cabinets. The books of the library are as carefully selected as the insects in the collection. I might mention that the moths and butterflies of Europe are particularly fine.

Herr Ribbe's collection was sold by auction during my stay in Dresden, and the chances of purchasing were remarkable. To give an idea, a fine cabinet, cork-lined drawers with glass tops (16 drawers) filled with inflated larvæ with the food-plants, was sold for 38 marks, equal to $9.50 in our money.

I next went to see Dr. Staudinger, at Blasewitch, on the Elbe, and here I saw the most wonderful collection that I have ever come across.

Dr. Staudinger has named his place the " Villa Sphinx," and has built the house on purpose to accommodate the vast collection which for years and years has been accumulating.

Here one can see most of the insects known and a large number of the collector's own types, as well as a very numerous collection of unnamed species, to which Dr. Staudinger was devoting his time (in describing) during my visit of nearly six months at Dresden.

The room that attracted my attention most, after seeing the collection, was the room used for the students or pupils as they are called, and where all the mounting, spreading, packing takes place as well as addressing boxes, and shipping insects ordered from every quarter of the world.

It is like a bee-hive and no one has time for idling here. One student is taking out specimens from papers and envelopes, another sorting and laying aside any that are difficult to determine (these are afterwards handed over to an experienced hand for determination). The third pupil is placing specimens in relaxing jars and glasses of wet sand. The fourth and fifth are mounting and spreading and often patching and mending broken specimens. The packing and shipping is done in the most orderly and business-like manner, and by dusk everything is finished for the day.

I noticed an improvement upon our relaxing tins and jars which may be worth mentioning. Glass covers are used and the advantage is obvious, as one can see the specimens through the glass. They are very much the shape of the glass dishes kept at the railway stations in the restaurants for sandwiches, etc.

The spreading is done rather differently from what I have seen in England and the United States in that very short pins are used for fastening down strips of paper over the wings, and forceps are used entirely (and never the thumb and forefinger) for tightening down the pins. Twenty specimens is considered a good hour's work of the smaller species and more of the larger ones can be satisfactorily mounted and spread by a good pupil.

Dr. Staudinger is engaged upon a gigantic work upon the Paleo-Arctic Fauna, which he is most anxious to finish.

At Berlin I saw Alex. Bau's collection and went twice to call upon Mr. Howarth but was not successful in my endeavours to meet him or to examine his fine collection. In Berlin I met Prof. Ramsay Wright, of the Toronto University, who was hard at work at Prof. Koch's laboratories. He very kindly took me to several places of great interest to a naturalist.

Arrived at London, I first went to see Mr. Henley Grose-Smith's collection of diurnals only. He had nearly doubled his collection since I last saw it in 1882. A splendid addition of new things had just been added, collected by Mr. Woodford, in the Solomon Islands. This collector underwent great hardships and evidenced his pluck by living for 18 months amongst the worst cannibals that are known in the islands of the Southern Pacific Ocean. Mr. Woodford's collection has been of great assistance to scientists interested in the insects of these southern climes.

Mr. Grose-Smith furnished me with a letter to Mr. Kirby, at the South Kensington branch of the British Museum, and no one could have been kinder than was Mr. Kirby. Always busy, he seems to be able to find a little time to devote to collectors who come to see the collections. He went through the Coliadæ with me and helped to clear up a number of doubtful species which I had upon my mind.

Last of all, I visited the Insect House, at the Zoological Gardens, in Regent's Park, and saw the breeding cages. A large number of North American diurnals, and all our large moths are to be seen here in their different stages of metamorphoses.

Europe, Asia and Africa are also well represented in this respect, and one is always sure to find something new and interesting to repay a visit to Mr. Bartlett's Insect House, at the "Zoo."

A MICROSCOPICAL EXAMINATION OF AN UNEXPANDED WING OF CALLOSAMIA PROMETHEA.

BY J. ALSTON MOFFAT, CURATOR, ENTOMOLOGICAL SOCIETY OF ONTARIO.

In the July No. of that ably conducted and instructive English magazine, *The Entomologist's Record*, the subject of wing expansion is discussed in its various aspects. Amongst those taking part in it, Dr. Buckell remarks that, "as to expansion: the unexpanded wing is a miniature of the expanded. Newman, at p. 14 of *British Butterflies* quotes from Kirby and Spence to the effect that the two membranes of which the wing is

composed are, in the unexpanded state, corrugated into a vast number of folds, transverse as well as longitudinal, and that the nervures are folded. Are any of our readers microscopists? If so, will they try and verify this statement." After reading that, and considering the matter, it occurred to me that I might be somewhat fortunately situated for making an attempt at discovering the facts of the case. First, because I was in possession of a number of the cocoons of large Bombycids which had failed to produce moths, therefore some of them might be found to be good subjects for investigation. And secondly, although not a microscopist myself, I was sure I could obtain the able and willing services of some members of our Microscopical Section: so I examined my cocoons. I had four *Samia Cynthia*, out of nine which I had received from Mr. James Angus, of New York. In three of them the caterpillars had failed to transform, the fourth contained a pupa. I had also two *promethea.* In one was the pupa of a large female, but so soft that it would not endure handling; in the other I found a small male, dry and firm. I called the attention of Mr. Foot, one of the younger members of the section to the subject and read to him Dr. Buckell's request; he at once responded with, "Let us try." I should state here that the investigation extended over several weeks. My method was to take notes of what I saw, or thought I saw, at any time during its progress, compare and correct them afterwards, and if there was conflict or uncertainty, I had further views to verify. But before entering into details I will quote more extensively from Kirby and Spence. In vol. 3 p. 293, we read, "To understand more fully the cause of this rapid expansion and development of the wings, though often exceedingly thin, they are always composed of two membranes, having most commonly a number of hollow vessels running between them. These tubes, which after the French entomologists, I would name nervures, contribute as well to the development of the wings as to their subsequent tension. In the pupa, and commonly afterwards, the two membranes composing the organs in question do not touch each other's inner surface, as they afterwards do; and being moist and corrugated into a vast number of folds like those of a fan, but transverse as well as longitudinal, and so minute as to be imperceptible to the naked eye, the wings appear much thicker than in the end. Now, as soon as the insect is disclosed, a fluid enters the tubes, and being impelled into their minutest ramifications, necessarily expands their folds; for the nervures themselves are folded, and as they gradually extend in length the moist membranes attached to them are also unfolded and extended. In proportion as this takes place, the expanding membranes approach each other, and at last, being dried by the action of the atmosphere, become one." This description seems to be taken from observations made of butterflies, which will doubtless differ in some respects from moths. We commenced operations by trying the Cynthia first. The wing-case was thick and hard; when broken and removed the winglet was disclosed lying close to the shrunken body, smooth and transparent as that of a fly; not the vestige of a scale visible, nor an indication of where they were to come from. Under the glass it was a most interesting object, but worthless for our purpose. The question forces itself on our attention here, At what stage of the pupal period does the scale begin to grow?

We next took up the Promethea, which proved to be in fine condition for the investigation. The wing cover came off freely and clean, disclosing the winglet scaled and coloured and apparently ready for emerging; when it was removed, it measured just over three-eighths of an inch from joint to apex, and one-fourth of an inch across the widest part; which possibly might have expanded to one and a half or two inches.

The first survey of it through the glass at once suggested compression, lateral and longitudinal, the minute scales were so crowded on one another that they almost stood erect, yet the ornamentation was distinct. When the scales were removed the transverse corrugations were disclosed, crossing the winglet at quite irregular angles, but the term "foldings," applied to them would convey an erroneous impression; drawings or gatherings would be more correct. They had an exact resemblance to some gatherings in ladies' dressmaking. The front edge had a singularly knotted appearance which I could make nothing of at the time.

Longitudinally, the foldings were unmistakable, but with nothing like the regularity of a fan; they were of quite unequal length and depth; some were but a slight de-

pression, others so deep that I could not remove the scales from them ; none of them extending from base to outer angle of wing. One would commence near the base, run deep and terminate in a loop. Another would begin opposite to the middle of that one, run beyond it and stop. Others formed plaits on the outer angle, all inclining to be wavy, as if they had been subjected to longitudinal pressure. These foldings would account for the broken lines of the transverse corrugations.

My next effort was to lay bare the nervures; for this end I soaked the winglet in water. It came out an elastic gelatinous mass. I tried hard to separate the upper and under membranes but without success. I turned it over to examine the underside, and found that the membranes had parted over some of the heavy nervures at the base of the wing, disclosing their structure completely ; the end next the joint of one of them turned upward, and I could see into the hollow tube as far as the bend would allow, the walls appearing to be very thin ; inside they were smooth with a waxy look. A general survey of the exterior reminded me of an earth-worm severely contracted. A close inspection showed them to be segmented ; one end of the segment was prominently rounded, sloping suddenly to the other end, entering the rounded end of the one next to it, and so on along the portion of the nervure laid bare, without any perceptible diminution in its size. If this structure is what is referred to in the statement, "the nervures themselves are folded," then the term is badly chosen and very misleading.

The condition of the costal edge of the winglet was now clearly displayed, but difficult to describe. If a piece of stiff twine is placed on the table, doubled back and forth in as short bends as is possible to give it, kept in place and looked at from above, it will give a good idea of the costa when it is viewed edgeways ; then cut the bends on the side representing the centre of the wing, and it will have a strong resemblance to the upper surface of the costal edge. The term, crimped, or crimpled, would well express its condition.

These views were obtained, and could only be obtained when the winglet was saturated with moisture. We may find in this direction an almost unlimited field for observation. From what we know of insects, we should be warranted in expecting as much diversity to characterize this as any other department of their history. A general principle may cover the whole, but with very considerable latitude in working out of the details.

The difference between the expanded and unexpanded wing is great in more ways than size ; the wrinkled thickness of the nervures in the one, is in striking contrast to the smoothness and fineness of the other. The amount of space between the rows of scales is very suggestive ; in the unexpanded wing the roots of the scales are close together, each row being situated on the crest of a wrinkle ; in the expanded wing the tips of one row of scales just cover the roots of the row in front of it ; when the scales are removed, the space between the rows of roots is a smooth dull coloured membrane. When contemplating this, I thought I saw an explanation of what I had observed when rearing Cecropias. Occasionally I would get one of unusual size, but they were always thin in vestiture and defective in colouring. Now if each specimen of a species has the same number of rows of scales on their wings, which may be the case, and the membrane of one becomes unusually extended, without a corresponding increase in the size of its scales, we can easily see what the consequences would be.

But the expansion of the scales themselves has to be accounted for. This takes place at the same time as that of the wing. From whence comes the motive power? It is known that the roots of the scales are bulbous, set in sockets, the bulb being under the surface of the membrane ; and that the scales are double, open inside, but closed at the outer end, forming a sac ; may not this opening extend through the stalk and root of the scale, connecting with the space between the two membranes of the wing, and receive from thence the impetus for its expansion? I tried to settle the question by various observations but obtained nothing definite, yet this seems to be the direction in which we have to look for the result produced.

I bethought me of the *Luna* I had seen when it had just emerged from its cocoon, which was pure white, resembling a bit of swan's down, so I examined the expanded wing

of one, but I found I had got into an entirely different field of observation, and one of a most surprising character; everything seemed to be the very reverse of what I had seen in Promethea. The scales were long, fine, and of a hair-like form, strewed thinly over its surface in quite an irregular manner; the beautiful green colour so much admired in the Luna, is not given off by the scales but from the membrane. The scales are yellowish, and the more numerous the scales the more yellow is the tint given to the wing. Many of the scales separate into branches, these branches separating again into finer ones, resembling some grasses we have seen. The scales around the "eye spots" are of the ordinary scale formation, the membrane under the coloured scales partaking of the colour of the scales. All of which goes to show that it is not safe to trust to one insect in order to get reliable information about the constitution of another.

Mr. Fenn calls attention to the usually more rapid expansion of the wings of butterflies as compared with the moths. On one occasion I was looking at the chrysalis of a *Danais archippus*, which I had fastened to a door frame, a little above the level of my eyes, when the pupa case burst, and the butterfly fell fluttering to the floor; by the time it had reached it the wings had attained their full length, but limp as a wet rag. With what force must the fluid be injected to the very extremity of the wings to produce such rapid extension! It gives no opportunity for observing the manner of its accomplishment; it is more like the relaxing of a compressed spring than anything else.

For such an investigation, probably the best results could be obtained from the examination of a fresh pupa, secured just before emerging.

Since completing this, I have had the opportunity of making another investigation.

In the latter part of October I received from Dr. Woolverton a fresh chrysalis of *Danais archippus.* I suspended it in a convenient place for observation, doubting whether it would mature or not at that season of the year. On the 5th of November it still retained its delicate, pellucid green colour, no perceptible change having taken place in it, except perhaps that the golden spots were more conspicuous. On the morning of the 6th it had become a deep, dull, bluish black; by noon the red colour of *archippus* was quite perceptible through the wing-cases, and by evening its black lines and white spots were distinctly seen. It had been maturing so rapidly that I was afraid to leave it over night, least it might burst its bonds before morning, so I gave it an alcoholic bath, which arrested its progress. Next morning it had an angular look, having shrunk a good deal. The outer integument peeled off freely, the pupa being well matured and firm to the touch. It required quite an effort to remove the winglet from the body, so completely had it matured. When taken off it measured nearly three-fourths of an inch in length, and was a perfect miniature of the expanded wing. A great quantity of fluid flowed from the wound made by the removal of the winglet, which soon reduced the body to less than one-half of its original diameter. The scales had the same crowded appearance as in Promethea; their tips had a flattened look, as if they had been pressed upon when growing, which turned them downwards; those of the fringes on the outer angle appeared as if they might be of their full length.

When the scales were removed the transverse corrugations were disclosed, showing them to be very much finer than those of Promethea, but there was not a trace to be seen of longitudinal foldings, not even on the outer angle; the lines of the corrugations crossing the wing were quite wavy, which would no doubt admit of a good deal of lateral expansion, but there were no plaits to let out, so I suspect there must be a considerable lateral compression to make up for it, although I could not detect anything in the membrane looking like longitudinal corrugations.

The winglet dried so rapidly that I made no attempt to lay bare the nervures, but there was no crimpling of the costal edge as in Promethea; the unexpanded wing being identical in form with the expanded one, which was not the case in Promethea. All going to demonstrate the certainty that we have in this direction abundant scope for investigation, each species probably having something peculiar to itself.

THIRD ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.*

August 17, Morning Session.

The third annual meeting was held in the Columbian University building, Washington, D.C. The meeting was called to order at 9.45 a.m., President Fletcher, of Ottawa, Ontario, in the chair. Thirty-eight persons were present, among whom were the following members:—

W. B. Alwood, Virginia; W. H. Ashmead, District of Columbia; G. F. Atkinson, Alabama; M. H. Beckwith, Delaware; Lawrence Bruner, Nebraska; A. J. Cook, Michigan; E. W. Doran, Maryland; James Fletcher, Canada; L. O. Howard, District of Columbia; D. S. Kellicott, Ohio; J. A. Lintner, New York; C. L Marlatt, District of Columbia; Herbert Osborne, Iowa; Theodore Pergrande, District of Columbia; G. H. Perkins, Vermont; E. A. Poponoe, Kansas; C. V. Riley, District of Columbia; J. B. Smith. New Jersey; E. B. Southwick, New York; J. M. Stedman, North Carolina; F. M. Webster, Ohio; H. E. Weed, Mississippi; F. H. Chittenden, District of Columbia; A. B. Cordley, District of Columbia; G. H. Hudson, New York; B. P. Mann, District of Columbia; M. E. Murtfeldt, Missouri.

PRESIDENT'S INAUGURAL ADDRESS.

The President, James Fletcher, Dominion Entomologist of Canada, then delivered his annual address.

Gentlemen,—It is not my intention to delay you upon this occasion either with a lengthened or an elaborate address, but I shall endeavour for a short time to direct your attention to some subjects for discussion which I trust may be found of interest and benefit to all present. These subjects are all of a nature which it seems to me may more appropriately be brought before this Association than before any of the other entomological organizations.

I am of the opinion that our meetings, to be of the greatest use to economic entomologists, should be largely of an informal nature; in fact, they should be meetings where workers can meet students in the same line of research and exchange experiences. We must all, to a large measure, go over the same ground and learn for ourselves the general principles of the structure and habits of insects which affect so closely the choice and application of the proper remedies to avert or mitigate their attacks upon crops. This training, however, is essentially necessary in the same way that learning the alphabet is necessary for one who wishes to read or speak accurately; but it is beyond this point that the advantages of our Association may be recognized. There is not, perhaps, any single line of practical science, certainly not one approaching it in the importance of the results attained, in which students have to work so much alone and cut off from companions of congenial tastes. Marvel at it as we may, we, who know the exquisite beauty and sustaining charms of the insect world, cannot but acknowledge that entomology is not a popular study, and although in this respect there is a gradual change taking place for the better, still all the same it is with feelings akin to amusement and patronage that the ordinary farmer allows himself to listen to arguments that there is after all *some* use in studying the habits of insects.

Probably most of us present have occasionally had the opportunity of addressing farmers' institute meetings, and know well that although, after the meeting is over, there

*The following report is taken from "Insect Life"—the official publication of the Entomological Division of the Department of Agriculture, Washington, D.C.

are invariably more inquiries about common insect crop pests than any other subject which may have been discussed, and when the meeting breaks up it is always the entomologist who is detained to answer the questions of those who did not like to stand up and speak before the others ; yet for all this, probably most of you will recognize the extreme similarity which exists between the expectant smile which meets you from every part of the audience when you are introduced to speak on insects in a new locality and that which greets the announcement of the high-class comic songs which are usually dispensed on those occasions. You also know the necessity, and have probably been often asked by the chairman at these meetings in so many words, to begin with some joke to "catch the attention of the audience." An appeal must then be made to their pockets, and you must remind them of the crops destroyed and dollars lost by depredations of pests which levy tribute every year, as the turnip flea-beetle, cut-worms, potato-beetles, etc.

You explain the simplicity of many remedies and the great saving that will follow their application. They had not thought of these things ; gradually the smiles die out and the other extreme of seriousness is reached. They awaken now ; with bodies leaning forward and heads raised they drink in every word ; their eyes brighten and their mouths gradually open with wonder at the losses they have suffered and might have prevented had they but known of these simple things before. It touches them to the quick to be told that ten cents' worth of Paris green would have saved their crop of gooseberries or currants ; have done away with the necessity of sowing their turnips two or three times at a hundred times the cost ; that ten cents expended in spraying an apple or plum tree would have given them a return of three or four dollars' worth of good fruit ; that by simply wrapping a piece of newspaper around their young cabbages or tomatoes at the time of setting them out they might have saved a loss of perhaps 75 per cent of their crop from the ravages of cut-worms. In short, that by following the advice of entomologists, those who study the habits of what they had always called indiscriminately "bugs," they might have saved much that had disappeared from under their very eyes.

But I need not now pursue this thought further. Encouraged by the apparent interest taken in the subject by the audience, one is sometimes tempted to speak too long, but we must be discreet: farmers, as a rule, prefer a few new thoughts at a time and to have these plainly put. Having finished, we perhaps sit down amidst applause and requests to go on, and perhaps hear such complimentary remarks exchanged as "I tell you what it is, there *is* something in what he says," or, in a tone of surprise "That bug man was pretty good." No. Farmers and ordinary individuals throughout the country who are dependent upon them for food do not know, nor as a class appreciate, what they do now, might, and will in the future owe to the labours of the entomologist. The consequence is that those who do take up the study are few and isolated from each other. Moreover, I maintain that there is no branch of natural science or practical agriculture to which it is second in importance. The amounts lost and the value of produce which might be saved every year in our staple crops alone, by following the advice of a competent entomologist, are so enormous and of late years have been so often proved, that before long the value of these studies must certainly be recognized. The chief hindrance is the widespread and incomprehensible ignorance on the part of both growers and consumers of agricultural produce of the present generation. This ignorance is rapidly being dissipated by means of the various agricultural colleges and experiment stations all over the world, where the rising generation is being trained.

It will soon be seen that the scientific or accurate study of the habits of insects, by which we are enabled to prevent the injury or loss of existing crops, of which we have already learned the use or necessity, confers far greater benefits on the community at large than the discovery or introduction of new products of which we have not yet felt the need. But there is no natural study which presents so many different aspects, nor which provides so many subjects concerning which its students, although they must know something, find it quite impossible to inform themselves thoroughly, which, in short, demands that its different branches must be taken up by several specialists bound together by some bond, so that the knowledge gradually accumulated by one may, at need, be

available for all. Such a bond I believe we have in the Association of Economic Entomologists, whose members have an opportunity of meeting once a year a large number of colleagues working in the same field, but upon different lines, with whom they can compare experiences and particularly can discuss any difficulties which may have arisen in the prosecution of their work during the year.

It is for this special reason that I set so much value upon an informal style of meeting, where the Association can, as it were, go into committee and a member can not only bring specimens for exhibition or identification, but can ask as many short questions as he likes and receive answers at once, together with opinions and comments, if necessary, from all present. Methods of applying and the most advantageous materials and proportions to be used in the manufacture of insecticides, the discussion of new discoveries either of materials or apparatus which may have come prominently before the public during the year, the most convenient modes of collecting, mounting and preserving material for study—all these seem to me to be subjects particularly appropriate for discussion before our association, concerning which, too, information is so badly needed now that the very progress of the science is seriously impeded by the want of it and which I think can not so well be brought up before any other existing body. Now these matters, although small in themselves, when neglected become of great importance, from the negative results which come out of them. I therefore took the liberty of addressing a circular to each member of the Association as well as to all economic entomologists of whom I could find the postal addresses, requesting them to come to this meeting prepared to derive the greatest possible advantage from intercourse with the eminent entomologists resident at Washington and those others who would surely be gathered together here; also at the same time to try to make the meeting enjoyable to others by favoring us with short notes of their operations during the year.

I am pleased to announce that one of our foreign members, Miss Ormerod, has sent us an interesting account of her work during the past year which will be read during the meeting.

Thanks to the kindness of Professor Riley and the trouble taken by our secretary, Mr. Howard, arrangements have been made that the visiting entomologists may take the greatest advantage of the opportunities afforded by the meeting being held at Washington, and I would suggest that all should impr ve this opportunity by examining and above all by taking copious notes of the various entomological machines, so many of which have originated in the Division of Entomology, under Professor Riley. To-morrow a certain time will be devoted to the discussion of insecticides and the machinery for their application. I am convinced, after many failures, that success in treating insects just as much depends upon having the proper apparatus as upon the insecticide used, and I draw your attention now to this subject because of the exceptional advantages offered here, not only from having the machines to examine, but also the able members of the staff to explain their uses. For my own part I have found it quite impossible to judge of and compare the merits of these, in many cases, expensive machines, by simply reading the available descriptions, and I think we should make the most of this opportunity. My only regret is that every economic entomologist in the country is not present. You will see by the printed programme which has been submitted to you that there are papers upon many important subjects and arrangements have been made by which our meetings shall not clash with those of either of the other bodies before which entomological papers are to be read, so that there is nothing to prevent members wishing to do so from being present at the reading of all these papers during this week. By a mutual arrangement with the president of the Entomological Club of the A. A. A. S. authors have been requested to submit papers of economic interest to this Association, whilst those of a scientific or systematic nature will come before the club or the section of biology.

I trust, gentlemen, I may not be considered presumptuous if I make use of the opportunity which you forced upon me when you elected me to this honourable position at the last annual meeting, to lay before you some ideas which have occurred to me by which we can make our work more useful and also secure better facilities for making it popular throughout the country. Why is it that the botanist, the chemist and the geologist do not elicit

the amusement only, from the ignorant, which is called forth by the entomologist in prosecuting his investigations? While not for one moment wishing to belittle their work I maintain stoutly that not one of these or all combined can compare with entomology in its possibilities when tested by the rule of *Cui bono?* The silent respect accorded these sciences is no doubt largely due to supposed, not to call them fictitious, virtues.

The botanist has from ancient times been inseparably associated with medicine and the discovery of a panacea for all the ills to which mortal man is heir. Even in the wilderness, with a handful of herbs he is exempt from molestation by either Indian or white man run wild. The chemist again deals with things unintelligible to the masses, illustrated with loud noises and nasty smells, and there has come down with him from the middle ages a sort of twin-brotherhood with the alchemist and the practisers of other dark arts—the possibility of his discovering in his laborarory an easy means of creating, without hard work, gold, that which is by most men most coveted, and for which many will commit crime or be induced to acts mean and contemptible. Too true even to-day are Virgil's words: "*Quid non mortalia pectora coges, Auri sacra fames?*" What will you not compel mortal breasts to do, cursed lust for gold? The geologist, with his pick, or his humble but sordid, vulture-like follower, the "prospector," means to the uneducated eye a public benefactor, who may find that purest but most degrading metal, the search for which is the mainspring and motor of so many lives. Who that has travelled in the far West has not seen the magic effect in removing difficulties of the words "I am working for the Geological Survey!" And yet—I say not as a wail—there is no such respect for the "bug sharp" or "grasshopper tenderfoot," who has saved them there, in that very country, the very means of subsistence, and he is only treated to shakes of the head and sinister looks, as though he were some dangerous character, when in answer to their questions "What are they for?" "What do you do with them?" he can not assure his interrogators that he either eats or, that which last of all he would do, sells his specimens.

But I have said that the change for the better in this respect has even now set in. Already the most highly civilized nations of the world, nobly headed by the Government of the most practical and energetic people on the face of the globe, the inhabitants of the United States of America, have seen the advantage of appointing specialists who can devise means for the prevention of the enormous losses of revenue due to the attacks of injurious insects. Germany, England and her colonies, notably Canada and particularly the province of Ontario, France, Italy, and other nations, all have followed the lead, and our favorite science has now changed from a study and amusement of the few to one of the most important branches of practical agriculture, the elements of which must be known by all engaged in tilling the soil or they will surely suffer. Already it finds a place upon the curricula of many of our schools and colleges and before long will force itself upon the notice of others. There has been a rapid development in this line, not only in this country but everywhere, during the last two or three years, and many new men have come to the front. My presumption does not carry me so far as to criticise these or other workers; but perhaps I may be permitted to refer to some of the dangers which beset a newly appointed entomologist, and particularly a young one. In such a task one must necessarily (for safety's sake) refer to what has occurred to himself in his own experience. The first consideration must of course always be to succeed in the work which you have undertaken, and I can not help thinking that some err considerably when they think that they will be expected to know everything and must answer every question off hand. On this point I am speaking particularly of our relations with farmers, who are as a rule very practical men, made so by the exigencies of their lives, but who are frequently those who have not had the advantages of a liberal education, and consequently have not the consideration and moderation which that alone gives. Moreover, as there is no policy so poor, because it is invariably seen through, as that which prompts an entomologist, when seeking information from one whom he knows is better posted than himself, to try and hide his lack of knowledge by making excuses why he does not recognise that exact specimen, or by asking indefinite questions in the hope of getting what he requires, without in so many words acknowledging his ignorance, so in the same way does he expose himself to the contempt and want of confidence

from those in whom he most desires to inspire respect, by trying to put them off with an indefinite answer. It has been my experience that a modest and honest acknowledgment of ignorance is no disgrace and brings no degradation with it, whilst an assumption of knowledge which we do not possess is a constant menace, which if once detected is never forgotten. It is the old tale, "honesty is the best policy;" but this must not end the matter; we must be honest with ourselves, and having once detected our lack of knowledge upon any subject which comes under our notice, we must use every means in our power of supplying the deficiency, and if we make a systematic study of every investigation which we undertake, taking all the time careful records of what we see, even with regard to the commonest insects, we shall frequently have the satisfaction of finding out that not only have we observed all that others have, but many other things besides, which will raise our simple investigation from a mere study into a scientific record. No man can possibly know everything even about his favorite study, and the sooner he knows this the better for his work.

A subject frequently referred to, but which can not too often be repeated is the necessity, or even, if we put it in another way, policy, of making the fullest acknowledgment of all assistance received from others, whether it be from their writings or otherwise. I know of nothing which so belittles a man's work as to find that it is derived without acknowledgment from some one else. It is not at all infrequent, I am sorry to say, to find whole sentences and clauses inserted in published writings without even quotation marks. An evidence of this is found in the innumerable mistakes which are perpetuated and handed down from author to author before they are detected as errors. Again, too great stress can not, I think, be laid upon the propriety of invariably acknowledging the source of all illustrations used. These are of the greatest assistance, and yet they are frequently used without a word of acknowledgment.

Now, all of this is essentially unwise from the base standpoint of policy alone; for although nothing may be said about the matter, be sure that every instance is noticed and stands forth as a black blot on the face of good work.

A defect which is occasionally discernible in some writings upon economic entomology is the want of a thorough grounding in the first elements of the science. This is easily detected; there is an uncertainty and indefiniteness about the work. It is like that of an artist who begins to paint pictures before he has learned to draw well. A far greater blemish, however, which has, I think, seriously impeded progress and effective work, is the fact that entomologists as a rule do not know enough about the collateral subjects which affect their studies. Their efforts are for the most part directed towards the protection of farm crops, and yet how few make a study or have much knowledge even of the elements of farming and horticulture, the growth and management of the various kinds of crops, the effects of different fertilisers, early and late planting, and the rotation of crops, the pruning and cultivation of trees and shrubs.

All of these are of paramount importance. The knowledge is necessary, and therefore must be acquired. A certain knowledge of botany is most important and will be constantly giving advantages to the one who possesses it over those who do not.

With regard to the presentation of the results of our labors for the use of others, one thing which should be avoided as much as possible is the recommendation of remedies which we have not actually tested ourselves. There are so many useless and untrustworthy remedies now published, particularly through newspapers, that great caution is necessary. Different conditions sometimes require differing remedies, according to circumstances: but I think that the best and fewest possible remedies should be given for any insect treated of, so as to simplify the application as much as we can. There is no doubt that the most valuable remedies are those which are simplest. As the late Mr. Frazer Crawford, of South Australia, has well said, a remedy must be (1) *effective*, so as to attain the object aimed at; (2) *inexpensive*, so as to be practical—worth the trouble and expense of application; (3) *simple*, so as to avoid as far as possible all chance of mistakes in applying it.

At the last meeting of the Association, in Champaign, Ill., I had the honor of a conversation with Assistant Secretary, the Hon. Edwin Willits, and he mentioned that he

was frequently asked for information as to the advisibilty of large expenditures for entomological purposes, and that although entomologists frequently spoke of the large losses from insects, we did not provide politicians—and particularly himself—with data by which they could explain and justify these expenditures, which those who understood them knew to be of such enormous importance, and when we wished to point out the great injuries done by insects we had to go back continuously to old published records which we had all been quoting for upwards of ten or twenty years. Now we find upon investigation that accurate estimates of damage done by insects are exceedingly difficult to arrive at, and the figures are so large that we are rather afraid to quote them ourselves lest we should prevent rather than encourage investigation, and it has been the custom of entomologists to minimise the estimates for fear they should not be believed. Now the necessity has arisen, I think, and I lay it before the Association for action, in the direction of gathering together some reliable recent statistics in a short form, which may be printed for distribution, and which will cover the more important injuries to date, and the part the work of the entomologist has played in reducing injury or preventing loss, so that we may overcome this difficulty and provide legislators and ourselves with data with which to meet this argument. After a careful examination and great effort to obtain data I have found that there are certain of these large estimates which appear to be reliable. I think better results will follow the publication of a few quite reliable statistics, which may be taken as typical instances, than by accumulating a large number of items which would increase the chance of error and might not be read so carefully. By way of example I will refer to the Chinch bug. I have examined carefully the estimates which have been published concerning that particular insect, and the following are probably quite reliable and appear to have been made with due regard to all collateral considerations, as the increased value of the saved crop, the cost of remedial measures, and similar subjects.

In 1864 Dr. Shimer's estimate, which I find was drawn up with very great care, put the loss in the one state of Illinois to the corn and grain crops at $73,000,000. In Dr. Riley's Reports on the injurious insects of Missouri, we find in 1874 there was a reliable estimate of the loss to that State by the same insect of $19,000,000. In 1887 Professor Osborn's estimate, founded upon the reports of the correspondents of the State Agricultural Society of Iowa, put the loss in that State on corn and grain at $25,000,000; and lastly, Mr. Howard's estimate, as given in the entomologist's report for 1887, for the nine States infested by the chinch bug in that year, was $60,000,000.

Now, gentlemen, I think these statistics of the injuries to crops by one insect alone are probably as reliable as any that we can get, and they give a good argument which we may use as showing the depredations of insects; but it is not sufficient that we can convince people that great injury is going on; we must show that we are doing something to mitigate this injury. In Professor Comstock's Report for 1879 the estimate of the possible annual loss in years of general prevalence of the cotton Aletia is placed at $30,000,000 through the cotton States. The injuries by grasshopers in the different States of the Union and also occasionally through the British North American provinces have been so enormous that figures hardly give an idea of the injury they do, but they are known by all to be enormous.

As an instance, however, of what may be done to mitigate their attacks I would merely mention those for this year, which seem to have been very considerable. In the States of North Dakota and Minnesota it is probable that at least $400,000 have been saved on account of work done by direct advice of entomologists—work they have in some instances forced upon the farmers. Two hundred thousand dollars is a probable estimate of the amount saved by plowing the land last autumn. Another equal amount has been saved by the use of "hopperdozers." Professor Bruner tells me that a sufficient number of grasshoppers have been actually taken this year, which if left alone and allowed to lay their eggs might next year have devastated the whole crops of those two States and the adjoining parts of Manitoba. These successful operations have been carried on by the state entomologist of Minnesota, Professor Lugger, and by Professor Waldron, of North Dakota, ably aided by the advice and assistance of the agent of the Department of

Agriculture, Professor Bruner under Professor Riley's instructions; and I think it is no exaggeration to say that at least $400,000 have been actually saved in hard cash on this year's crop, not to speak of the enormous loss which would most probably have followed next year had they been left alone, and had climatic conditions been favorable for their increase.

The amount of damage done to crops every year is so vast that the figures excite incredulity from those who do not study crop statistics. The agricultural products of the United States are estimated at about $3,800,000,000. Of this it is thought that about one-tenth is lost by the ravages of insects. This is in many cases unnecessary. In short a sum of $380,000,000 is given up without a murmur and almost without a struggle by the people of the United States.

Crops of all kinds are injured, and simple remedies are known for many of the attacks and are more or less adopted. Some have already come into general use. Paris green is now applied to potato fields almost as much as a matter of course, as manure is to fertilize the soil. As an instance of how a saving may be made even in well-established methods, I give the following: Through the work of Mr. W. B. Alwood, of the Virginia experiment station, improved machinery and the water mixtures of poisons have come into general use amongst the farmers and potato-growers in the Norfolk region. and some of the largest growers now claim that they at present do for from $10 to $60 what used to cost them from $500 to $600. To-day in California and Florida, orange trees are universally treated with kerosene and resin emulsions or poisonous gas for scale insects.

In the treatment of cabbage caterpillars, pyrethrum diluted with four times its weight of common flour, and then kept tightly closed for 24 hours, leaves nothing to be desired, and thousands of dollars are yearly saved to small growers who most need the assistance.

Many excellent remedies have been devised by a mere modification of existing agricultural methods. Instances of these are found in the early and late sowing or harvesting of some crops, as sowing turnips between the broods of the turnip flea-beetle, the late planting of cabbage for the root maggot, the late sowing of wheat for the Hessian fly, etc. In the 1879 report of the U. S. Department of Agriculture was first detailed the only successful method of treating the clover-seed midge by cutting or feeding off the first crop before the young larvæ are sufficiently matured to leave the heads and go into the ground to pupate. This was simply the change of one week, by which not only is the insect destroyed, but the clover is saved in better condition than under the old method.

During the present summer Professor Osborn has discovered that a serious pest of the clover plant, *Grapholitha interstinctana*, a small moth, may be destroyed in all its stages by simply stacking the hay soon after it is cut.

In the Southern States Mr. Howard Evarts Weed writes to me with regard to the cotton worm: "The loss would indeed be great were it not for the fact that the planters keep it in check by the prompt application of Paris green in a dry form. The only method now used is to apply it by means of two sacks attached to a pole and borne through the plantation by a negro mounted on a mule who rides down the rows of plants. This gives perfect satisfaction, and the farmers of the state tell me that they want no better remedy for this insect."

Mr. F. W. Mally writes on the same subject: "The benefit which the public generally derives from the researches of economic entomologists is well illustrated by the result of the cotton-worm investigation published in the Fourth Report of the U. S. Entomological Commission. In that report estimates of damage, etc., are given. and I will only allude to the benefit which the planters have derived from the report. Formerly, planters waited until the August brood of the Aletia issued and depredated on their cotton. This brood may be called the migratory one, since it spreads over vast areas of cotton fields. At that time, too, the planters used Paris green just as they purchased it from the dealers. They have now been educated to know that the Aletia propagates in certain quite well-

defined centres earlier in the season, and that if taken in July (or about five weeks earlier than they had been accustomed to), they can prevent their spreading to larger areas. Now, too, they dilute the Paris green with flour and finely-sifted wood ashes, greatly reducing the cost of the poison per acre. At the same time the acreage or area to which poison is now applied has been reduced tenfold, at least. For example, here in the Red River Valley, for 30 miles up and 50 miles down the river in July there were only two plantations (together about 2,000 acres) upon which Aletia was found. In August this brood would have spread over almost the entire section mentioned. Paris green was applied to this limited infested area, and the larger areas saved from injury. The saving is hardly to be estimated. The above appears to me to be one of the greatest triumphs of economic entomology, and, I may truthfully say, also of my most estimable chief, Dr. C. V. Riley."

With regard to another injurious insect, the following facts well illustrate what may be done by following the advice of an experienced entomologist.

During the year 1885 the Hon. Moses Fowler, a wealthy banker and landowner of Lafayette, Indiana, applied to Prof. F. M. Webster, an agent of the United States Department of Agriculture, then located at that place, for relief from very serious depredations by an unknown enemy to his corn, which was damaging some of his fields from 5 to 75 per cent., he having this year 10,000 acres of land devoted to this crop. Upon examination the depredator proved to be the well-known corn-root worm, the larva of *Diabrotica longicornis.* Mr. Fowler estimated the loss in his fields by reason of this insect at $10,000, with a probability of still greater injury the following year. On the advice of Mr. Webster, the next season he sowed 5,000 acres of the worst infested lands to oats, and the following year the other 5,000 acres was treated in the same manner, the first 5,000 acres being this year again devoted to corn. As a result of a continuation of this rotation the pest has been practically exterminated, thereby, according to Mr. Fowler's estimate, saving him $10,000 per annum.

Professor Osborn has shown that grass insects destroy much produce. He estimates that the small leaf-hoppers (*Jassidæ*) destroy as much food from two acres of pasture as would feed one head of stock. From recent experiments he has found that it is possible by the use of hopperdozers to reduce the numbers of these insects so materially that, upon two plots, chosen for their similarity of the conditions of the growth, the amount of hay produced upon a plot which was once treated with the hopperdozer was 34 per cent. greater than upon the corresponding untreated plot.

I have said that the study of economic entomology is many sided and requires many workers. It is equally true that all who would keep up with the rapid development which is going on all the time must work day and night, early and late. The various habits of so many different objects of study, many of them nocturnal, require constant attention.

In conclusion, I would urge on everyone the great importance of keeping the most careful notes of everything which affects their work, not only of what is seen in one's own investigations, but of whatever is found in the literature of the different subjects studied: there is perhaps no detail of our work which so well repays the slight extra trouble which it involves as making all notes carefully, completely and neatly, and then putting them away systematically, so that they can be found when required suddenly on some future occasion. Our "private notes," as we call them, should, I think, be made with the greatest possible care, not only for our own sakes, but to insure that they may be of use to others after we are gone. Who has not felt the disappointment on looking through the collection of some great worker suddenly called away from this life, of finding rare and interesting specimens, without a single note of locality, date, or other information, and how comparatively useless such specimens, and even the labor by which they were bred or procured, are thus rendered. We all know this, and yet how, too often, do we put aside material without labels, thinking that we know and shall remember all about them. After many years of much wasted labor I have come to the conclusion that a few specimens well preserved, properly mounted, and with full notes, are far more valuable than a large number of specimens without these characters.

When a collector once gets the habit of accumulating a large number of specimens of everything he sees, he very soon gets careless about putting them away while they are in good condition, and has not time to make the proper notes.

Not only should notes be taken of what we ourselves have seen, but much time will be saved if an index book be kept of all literature which passes through our hands. Even in this we must protect ourselves. The time of an enthusiastic entomologist is necessarily short, and he has not time to "look through" books on his work to see if they are good, with the idea that he will remember where to get the contained information at some future time. All reading must be done earnestly and keenly as though we should never again have an opportunity of seeing the book in question. Let all our labour be work, not play. I think it is John Ruskin who defines work as systematic effort with a definite end in view, while unsystematic effort, no matter how severe the labour may be, if it have no definite end, is merely play. In the index book should be entered a reference to the page where any facts which strike us as useful are to be found. Some restraint will be necesaary, when this work is once taken in hand systematically, not to index what is not useful, as well as that which is. It is very easy to get a mania for indexing, and then the gems we are picking out may soon be lost amongst less valuable matter. Whatever we have to read or whatever we have to see, let us give it our fullest possible attention with the idea that at some future time the information may be useful. A tale that is told about Henry Ward Beecher illustrates this very well, and is probably known to many of you. Upon one occasion he was driving in the country and his horse cast a shoe. He had always made it a rule of his life that whenever he had to see anything done he gave it his fullest attention, with the idea that at some time he might require the knowledge so obtained. He had frequently stood by whilst his horse was being shod, and consequently, when after a time, he reached a country village and found that the smith was away from home, the tale goes, he felt so confident of the knowledge he had acquired from watching carefully other horseshoes made that he lighted the fire, fashioned and finished a shoe, and shod his horse. He drove on about ten miles and reached another village. Upon passing the forge of the village blacksmith he thought it wise to have his work examined, so went in and explained the circumstances and asked the man to see if all were well. The smith looked critically at the shoe, examined it from every point of view, looked at the nails and the way in which they were clinched, and then raising himself up, said: "Look here, mister, if you made that shoe yourself and put it on, as you say, you had better give up preaching and take to smithing."

Gentlemen, I thank you for the kind hearing you have given me, and I trust we may have a pleasant and useful meeting.

Mr. Osborn, in discussing the address, thought that the subject suggested by the President, of the great importance of careful statistics, could hardly be overestimated. He moved the appointment of a committee of three to operate with Mr. Fletcher to prepare, if possible, some careful statistics as to the amount of insect damage, and as to the benefit resulting from the work of economic entomologists.

Mr. Riley indorsed the suggestion. He had been greatly gratified with the address and with the many valuable ideas which the president had put forward. Most entomologists who had treated of the losses occasioned by insects to agriculture have followed in the wake of Walsh, who had stated a quarter of a century ago, upon general estimates that the annual loss from injurious insects in America was $300,000,000. Since his time the values in crops had greatly increased and the proportionate injury should have also increased; but we must take into consideration the advance in economic entomological knowledge, which has greatly reduced the proportionate loss. The loss is at most a relative thing, and we must always remember that with a decrease in the amount of

the crop its money value is correspondingly increased. The present year is an exception, and we have abundant crops in this country with high prices as a result of failure in other parts of the world. He hoped that Mr. Osborn's motion, which he seconded, would be adopted, and he felt sure that such a committee would accomplish good results.

Mr. SMITH spoke of the unreliability of the testimony of farmers on the question of insect damage, and adduced as an instance the fact that this year the Melon Plant louse is very abundant in New Jersey, and that all melon injury is attributed to this insect, but upon careful examination the main trouble is found to be a bacterial disease.

Mr. WEED spoke in the same line, and stated that in Mississippi great damage was attributed to the Boll Worm of Cotton, which was not done by this insect, a number of species uniting in producing it.

Mr. POPENOE had found a similar misapprehension with regard to affairs in Colorado, and damage to the potato crop by the Colorado Beetle was laid at the door of the locust so abundant there, *Dissosteira longipennis.*

Mr. FLETCHER was of the opinion that the statistics should be gotten up by the entomologists themselves by the most careful personal examination and without reliance upon the statements of farmers.

Mr. SMITH called particular attention, not to the confusion of the damage done by different insects, but to the confusion of insect damage with that brought about by fungus or bacterial disease.

The motion was put and carried, and the President appointed Messrs. Riley, Osborn, and Smith as the committee.

On motion of Mr. HOWARD it was resolved that the committee be authorized to publish their results in case sufficient data for publication should be collected before the next annual meeting.

The SECRETARY reported that the minutes of the last meeting had been published in No. 5, Vol. III., "Insect Life"; that the past Secretary had transferred the treasury to him with a deficit of 38 cents, and that he had been at some expense for circulars, postage, and posters.

On motion of Mr. COOK, a tax of $1 was levied on each member present.

By vote of the Association, Dr. James Stimson, of Watsonville, Cal., was elected a member. The credentials of Mr. H. E. Weed, of Mississippi, were presented by Mr. Fletcher; those of Mr. F. L. Washburn, of Oregon, by Mr. J. B. Smith; those of Mr. J. W. Toumey, of Arizona, by Mr. Weed; those of Mr. F. H. Chittenden, of the Department of Agriculture, Mr. A. B. Cordley, of the Department of Agriculture, and Mr. F. J. Niswander, of Wyoming, by Mr. Howard. All were inscribed as members of the Association. Mr. A. S. Olliff, of Sydney, New South Wales, was inscribed as a foreign member.

A communication was read from Mr. Forbes concerning the desirability of holding the meeting of 1893 with the Columbian Exposition at Chicago. Action upon this communication was deferred.

On motion of Mr. SMITH, it was resolved that all insecticide papers should be brought together on the programme for Tuesday afternoon.

DESTRUCTIVE LOCUSTS OF NORTH AMERICA, TOGETHER WITH NOTES ON THE OCCURRENCES IN 1891.

BY LAWRENCE BRUNER, LINCOLN, NEBR.

In introducing this subject it is my intention to speak shortly upon the various species of locusts which have appeared in injurious numbers within the limits to be designated with each species. Some of these species have covered a vast area of territory, and have caused extensive injury from time to time, while others have appeared over limited areas and have caused but slight injuries; yet these injuries have been sufficient to necessitate their mention among the destructive species of the country. Taking them all together we have exactly twelve destructive locusts within the territory designated.

Selecting the species as they occur to me, I will mention first the Long-winged Locust, *Dissosteira longipennis*. During the early part of July reports came from the eastern and south-eastern portions of Colorado of locust depredations. The first of these was that trains had been stopped by grasshoppers getting on the rails of the Santa Fé Railroad 100 miles or thereabouts east of Denver. Shortly after this reports appeared in the newspapers of serious damage being done around the point where they were first mentioned as stopping trains. About this time other reports of depredations came in from North Dakota and Minnesota and other portions of the West and North-west. On the strength of these reports Professor Riley instructed me to visit the localities for the purpose of ascertaining the extent of country over-run, the actual and possible future injury which might result, and the exact identity of the species concerned. Being a Nebraska man and looking out for first interests, I naturally went to Colorado, the nearest locality to my home from which reports had been received. I first visited Akron, Colorado, the nearest point on the Burlington and Missouri line to the region infested. There securing a team and driving to the south only about six miles, the advance guard of the enemy was encountered. Imagine my surprise at finding here an entirely new insect as far as destructive locusts are concerned. Here in Colorado, and in immense numbers, was the *Dissosteira longipennis*, an insect usually considered rare in collections, and one heretofore only known to occur over the higher portions of the plains lying to the eastward of the Rocky Mountains, in the States of Wyoming, Colorado, and New Mexico. This insect, as ascertained from inquiry, covered an area of about 400 square miles of territory in sufficient numbers to materially injure the grasses growing on the ranges of the entire region, and amongst these grasses the species of *Bouteloua* or Gramma grasses, and the Buffalo grass, *Buchloe dactyloides*. Grains and other cultivated plants did not appear to be especially attractive to it. In fact very little or no injury was done by it to the cultivated crops growing within the region infested. About the same time that I was investigating this insect upon its northern line of injury, Professors Snow and Popenoe were studying it upon the southern border of its range, and they found practically the same food habits there that I had noted in the north, and by inquiry found that the insects had come into that country from the south last fall and had laid their eggs over a large area. This year when the eggs hatched, the young began to move from their breeding centres in all directions, seeking open places and the edges of plowed fields and following roadways. This trait of seeking open spots this season is probably due to the habit of the insect of naturally living on open ground, where grasses are short and scattering. The present year was very wet in this particular region and caused an undergrowth of grasses; hence the desire to find the natural conditions under which the insect lives. The young began moving, and, finding these open places, congregated there. Having thus congregated, they must naturally feed, and they swept the grasses clean around these spots. So noticeable was this that, in certain spots where they had gathered about the hills of a species of ant which raises mounds of small gravel and cuts away the vegeta-

tion for some distance around them, they had enlarged these areas in some places for fully half an acre. This year Messrs. Snow and Popenoe observed them flying southward with such ease, by reason of their long wings, that they resembled birds.

Dissosteira obliterata, Thomas.—Closely related to the above, and very similar in appearance to it, is a second species of these large, long-winged locusts, which was found in injurious numbers along with *Camnula pellucida* in Idaho last year. It was quite common in the Wood River country lying north of Shoshone and in the vicinity of Boisé City, Idaho. One form of this species was described by Saussure as *Dissosteira spurcata* in his *Prodromus Œdipodorum.* This is not the *Œdipoda obliterata* of Stoll.

Camnula pellucida.—This is the insect which has occasionally been very destructive in parts of California and Nevada. It has since spread eastward into Idaho, where it is very destructive the present season, covering an area of at least 1,300 square miles of territory. It also appears in great numbers, with several other species, in the Red River Valley of Minnesota, North Dakota, and Manitoba. I also observed it abundantly in the Prickly Pear and Gallatin Valleys of Montana, near the mouth of the Yellowstone. in North Dakota, in portions of Wyoming, Colorado, and the extreme western part of Nebraska. It also occurs in the New England States and British America. This is a species which readily adapts itself to any new locality, being the most easily acclimated of any of our injurious locusts. When once domiciled, it is there to stay, and will require our earnest attention from time to time in the future. In fact I consider this locust, though not migratory, fully as destructive as the Rocky Mountain or true migratory locust, from the fact that it so soon becomes acclimated.

Acridium americanum, Drury.—This large, handsome locust is the species which occasionally devastates Yucatan, Central America, and Mexico, and even reaches the United States in injurious numbers along our southern coasts. It has also been known in dangerous numbers as far northward as the Ohio River, and occurs sparingly as far north as the northern States, but I imagine never reaches British America.

Dendrotettix longipennis, the Post Oak Locust of Texas.—During the spring of 1887, while visiting Washington County, Tex., to investigate a local outbreak of an injurious locust, I heard of a species that was attacking the oaks of that particular region, and in some places entirely defoliating them. On my way from the region where I had been working to the city of Brenham, we passed through the infested locality, and I obtained some of the insects in question, which were then in the larval stage. A careful examination proved the insect to be new and congeneric with a species heretofore collected only in the vicinity of St. Louis, Mo., and which also occurred only on oak. About a year later this species was described by Professor Riley under the above name. The insect occurs in two forms, long-winged and short-winged. The former flies with great ease and often leaves the trees in midday and alights in fields and other clearings; with the least disturbance it flies to the tops of the adjoining trees. The larvæ and pupæ are also exceedingly active and run over the branches and trunks of trees with great rapidity. The eggs are laid in the ground around the bases of the trees. An area of at least 50 square miles of forests was completely defoliated by these insects during that and the previous year.

Melanoplus spretus, Thomas, the Rocky Mountain or Migratory Locust. This is the insect which is generally referred to as *the* destructive locust of North America, and has caused more injury during the past 20 years than any dozen of the other species combined. It is this species which we most fear on account of its migratory habits; so marked is this trait that swarms hatching on the Saskatchewan have been traced to the Gulf of Mexico in one season. Its habits have been so frequently described that further mention is unnecessary. Suffice it to say that at the present time it is again decidedly on the increase along our northern boundary. During the present year reports of its injury were received from Minnesota, North Dakota, and Manitoba by the Department of Agriculture, and upon investigation I found these reports to be only too true. In Minnesota and Dakota

the authorities, ably assisted by the efforts of settlers, have been carrying on a vigorous warfare with marked results, which will doubtless save their crops from devastation next season.

Melanoplus atlanis, Riley, the Lesser Migratory Locust.—This locust, which very frequently becomes very injurious on account of its excessive increase, is somewhat smaller than the Rocky Mountain species. It is also migratory in its habits, but to a much less degree than is *spretus*. In its distribution this insect is much more widely spread than the preceding, being common in almost all parts of our country from the Mexican boundary to the fifty-third degree of north latitude, and even beyond in some parts of the country. It is the species which most frequently does the locust injury in the New England States, much of that in our Northern States, and some in the extreme Northwest. It has also been known to become injurious even in the Middle or Southern States. In its distribution *atlanis* appears to be more partial to hilly or mountainous country, and especially is this noticeable in reference to its appearance in destructive numbers. It also seems to prefer wooded or mixed country to the open prairie or plains.

As would naturally be expected from its wide distribution, this particular locust presents some variation in its size, color, and, to some extent also, its structure. At any rate there appear to be three well-marked forms of the species to be met with within the confines of North America.

Melanoplus devastator, Scudd.—A third species of the genus Melanoplus is the one that occasionally appears in destructive numbers in portions of California and the adjoining States. It is about the same size as the *atlanis* just mentioned, and often does considerable injury to the crops of the regions where it occurs. Although this locust is known to inhabit almost the entire region lying to the west of the main divide of the Rocky Mountains and to reach even beyond in Montana and Colorado, it has never, to my knowledge, been injurious except in Nevada, California, Arizona, and Oregon. This species also occurs in two forms, viz., small and large, being the spring and fall broods as nearly as I have been able to decide from specimens in collections.

Melanoplus bivittatus, Say, the Two-striped Locust.—This is our common species of native grasshopper all over the country, and the one that so frequently becomes injurious in our gardens and about the edges of fields. It occurs from the Atlantic to the Pacific, and from the Gulf of Mexico to the Saskatchewan. Its increase in destructive numbers appears, however, to be confined chiefly to the regions lying between the Rocky Mountains and the Atlantic. This locust also appears to vary considerably in its size and colour. There are, however, two well defined forms, the one receiving the name *bivittatus* and the other going by that of *femoratus*, the latter occurring only northward.

Melonoplus differentialis, Thomas, the Differential Locust.—Next to the species just mentioned we frequently find a second species of our large native locusts appearing in destructive numbers. This latter species occurs in the Western and Middle States only, and here is very often known to become unduly numerous and destructive to both the field and the garden crops. It has been reported at different times to have been present in such numbers in portions of Illinois, Indiana, Missouri, Kansas, Iowa, and Nebraska. A melanic or black form is quite frequent in portions of Nebraska and Kansas, but otherwise it is quite permanent in its character.

Melanoplus ponderosus, Scudd., the Ponderous Locust.—An insect very closely related to the preceding is that known to the entomologist by the above name. It is a native of several of our southern states, and has on several occasions been a depredator of crops in portions of central Texas. As the name would imply, it is of robust form, and has a somewhat similar appearance to the *differentialis*.

Melanoplus femur-rubrum, De G., the Red-thighed Locust.—Last on the list of destructive locusts for North America north of Mexico, is herewith presented the one that

perhaps enjoys the greatest geographical range of all our species. It is the common locust in all parts of the country from the Atlantic to the Pacific and from the Arctic circle to Central America. Its devastations, while perhaps not as vast as some of the preceding, have been more frequent and have occurred at more localities than those of any other one. Like the *bivittatus*, *differentialis*, and several of our non-destructive species, *femur-rubrum* is a frequenter of rather low places and rank vegetation.

After giving these brief notes on the various species of locusts that have been known in the past to have been connected with the injuries from this class of insects within the country, it will not come amiss for me to say a few words about the subject for the present year, and to give my opinion as to the probable outlook for the coming year. Briefly, then, let me say that there have been received reports of locust injury from the following states :—Alabama, Mississippi, Texas, New Mexico, Arizona, California, Idaho, Colorado, Kansas, Nebraska, North Dakota, Minnesota, Iowa, Indiana, Ohio, Michigan, and New York. In fact, there have been more separate reports received the present year than ever heretofore from this cause.

Now a word or two as to the different species of these destructive locusts that are responsible for the injuries of the present year. In California the *devastator* is present ; the *Camnula pellucida* is known to be unduly common in Idaho, Minnesota, North Dakota, and parts of the Rocky Mountain region ; the Rocky Mountain or migratory locust is the one that is responsible for much of the injury that has been reported from the Red River Valley of Minnesota and North Dakota as well as in Manitoba to the north of the international boundary ; *Melanoplus differentialis* is the one that must receive much of the blame for Kansas and Nebraska injury, while in the states of Indiana and Ohio *femur rubrum* and *bivittatus* are the guilty parties. *Melanoplus atlanis* is present in injurious numbers in the Red River Valley along with *bivittatus*, *spretus*, and the *Camnula pellucida*. In Colorado and New Mexico for the first time *Dissosteira longipennis* has appeared as one of the injurious species of the country.

While all of these locusts, along with almost every other species of the group which is native to North America, are to be counted as injurious, the particular one that has been the dread of the whole country, and especially of the region lying between the Mississippi River and the Rocky Mountains, is the migratory species—*Melanoplus spretus*. This insect is now on the increase in a limited area on our northern boundary and across the line in the province of Manitoba. By continuing the prompt and energetic efforts that are being carried out by the populace and state authorities of the states of Minnesota and North Dakota we can be assured of success only provided the Canadian government will also see the advantage of co-operation at this time. This, let me state, is all the more necessary at this particular time, as all reports seem to indicate that at present this locust is not present in abnormal numbers in any other part of the entire country. A stamping out of the pest in this region might, therefore, forever give immunity from their further injury.

Finally, let me urge on the inhabitants of all infested regions that " a stitch in time saves nine." In other words, we do not know what the climatic conditions may be a year hence—whether they will be such as to favor the hoppers or not—so we should do the wise thing and stamp out the pest. This has been done time and again in the past, and the recent work in the north shows how very profitable is the warfare when carried on persistently. By the plowing under of the eggs laid last fall, and the use of the kerozene pans or hopperdozers in the destruction of the young locusts that did hatch, the twelve counties in the two states of Minnesota and North Dakota saved, by actual computation, on wheat alone, the sum of $400,000. This, mind you, was in a year not considered a locust year, and does not take into consideration what was saved in the region in other crops and the injury that might have resulted next year had the hoppers not been destroyed. With every favouring circumstance, the comparatively few locusts of this one species that have thus far been destroyed the present year in this region would have been sufficient to overrun, at least calculation, the entire area of the state of Minnesota, the two Dakotas and Nebraska, along with portions of Iowa and Kansas. True, these favouring circumstances might never occur, but it is always best to be on the safe side. This we should know from our past experiences with this same insect.

"Native" locusts, while perhaps not to be dreaded equally as much as the species just spoken of, certainly can commit an equal amount of injury when size and numbers of the insects are taken into consideration. They cannot, it is true, get up and fly away to regions new, but they are equally rapid breeders, with favouring conditions They can be destroyed equally as well, if not better, than can the Rocky Mountain species, on account of their local restrictions, even in the regions where found.

Mr. Southwick had noticed *Melanoplus femur-rubrum* flying to the tops of grasses towards sunset in the fields near New York City.

Mr. Osborn had noticed the same habit. He spoke of the great difficulty of estimating the damage done by grasshoppers. Some discussion followed upon this point by Messrs. Southwick and Atkinson.

Mr. Cook stated that *M. femur-rubrum* had been very abundant in Michigan for three or four years back, but that he had no difficulty in estimating the damage to oats. He thought that the outlook in Michigan was not at all serious, and considered that perhaps Mr. Bruner's prediction was too doleful.

Mr. Bruner stated that we cannot take any chances. The black picture is justifiable if we make people work to destroy the insects and the local species have it in their power to become serious pests.

Mr. Webster stated that *femur-rubrum* is the species which is doing the damage in Ohio. He had noticed a fungus parasite working to a considerable extent near Columbus.

Mr. Smith thought that Mr. Bruner's point that it is unsafe to predict comparative immunity on account of a tendency of farmers to shirk work was a very good one.

Mr. Cook stated that there was another side to be considered, for if the entomologists predicted danger and the farmers did no work and the plague did not come, the entomologists would be forever discredited.

Mr. Weed spoke of the cotton worm, and stated that where the planters were always ready with their stock of Paris green they were in condition to fight the worm whenever it appeared in numbers.

Mr. Webster thought it was always best to tell the truth and to frankly admit all inability to give valid predictions.

Mr. Fletcher was of the opinion that in all probability predictions can be made more confidently in the western country worked over by Mr. Bruner than in Canada and the region spoken of by Professor Cook.

CHILO SACCHARALIS IN NEW MEXICO.

BY C. H. TYLER TOWNSEND, LAS CRUCES, N. MEX.

On July 8, 1891, I found a considerable number of stalks of young corn on the college farm infested with a borer. The borer enters by a hole in the stalk a short distance above the ground, and bores down into the root. It makes its burrow exactly down through the centre of the stalk, and some go upward a considerable distance also. The infested stalks are easily known by the tassel and most of the top being entirely withered and white or yellow. Some stalks showed the work of more than one borer evidently, unless the same one had eaten out and then eaten in in other places. In several stalks the live chrysalids of the borer were found near the bottom of their burrows, in the root, about even with the surface of the ground. From these pupæ two of the moths were bred, issuing July 12th. Sorghum grown near the infested corn on the college grounds could not be found infested by the borer. The same borers were sent to the college from Eddy, New Mexico, with report of much damage to corn. In many cases on the college

farm the chrysalids were found dead and decaying in the burrows in the stalks. A dead larva was also found some distance above ground in a stalk. More dead pupæ than live ones were found, and probably this is the result of irrigation, which makes it too damp for the pupæ lodged in the roots and engenders disease.

In discussing the paper Mr. Weed said that this insect damaged corn to some slight extent in Mississippi, and considerably more so in Louisiana.

Mr. Howard said that this species is spreading northward rapidly through the Southern states and has reached the southern border of Maryland, but that it is not a pest to be feared with the methods of careful cultivation in vogue at the north.

A NOTE ON THE WHITE GRUB OF ALLORHINA.

BY C. H. TYLER TOWNSEND, LAS CRUCES, N. MEX.

On the 30th of April, 1891, I had a spot of ground on Judge Wood's place, near Mesilla, dug into for white grubs. The particular spot dug into was selected because white grubs had been found in it before, although I was assured by Judge Wood that not a particle of vegetation, not even a weed, had grown on it for at least three years, and probably four. It was a bare spot in the back yard, and by digging over a square foot or two of ground sixteen grubs were secured, at from six to ten inches below the surface. These grubs were all about the same size, and apparently nearly full grown. The ground contained no roots of any kind, but their food habits in this barren soil were explained in this manner: They were left over night in a tin can in earth in which was also placed an elongate white larva about an inch and a half long that had been found in the earth at the same time with the grubs. The next morning nothing but the caudal extremity of this larva could be found; the white grubs had devoured it. If this carnivorous habit is known of *Allorhina* I am not aware of it. I know that some other Scarabaeid larvæ have been found occasionly carnivorous. But *Allorhina* I had supposed lived only on roots of grass or other plants.

There is no complaint in this country of injury to roots of alfalfa or grasses by white grubs, yet the adults swarm in the summer and destroy much fruit, and the ground is full of their grubs.

Ten of the above grubs were placed in a jar of earth to breed. On July 24th, 1891, two imagos of *A. nitida* were found in the jar on the surface of the earth.

Mr. Alwood stated that he had bred a dipterous parasite from the adult of *Allorhina nitida.*

Mr. Marlatt thought that this instance of Mr. Townsend's was interesting, but that it proved no general habit. He considered that the ground was probably rich in vegetable matter so as to afford food for the white grubs.

Mr. Smith thought that it would be interesting to know what the other larva fed on.

Mr. Popenoe expressed himself as surprised at the extreme south-western distribution of the species.

Mr. Marlatt then read a third paper by Mr. Townsend.

NOTES OF INTEREST.

BY C. H. TYLER TOWNSEND, LAS CRUCES, N. MEX.

A specimen of the Colorado Potato-beetle (*Doryphora 10-lineata*) was taken July 12th, 1891, on our common wild purple-flowered *Solanum* here. It is the only specimen I have seen here.

The Bean Epilachna is in full force on the college farm. All stages, from eggs to adults, found last of July. Some experiments in spraying with Paris green were tried. The results up to August 1st were negative, neither the insects nor the plants being killed. The solutions were purposely made very weak.

The latter part of July, 1891, the Bollworm (*Heliothis armigera*) was found in nearly every ear of corn in a patch on the college farm. They were of all sizes and colours, and were accompanied almost invariably by large numbers of Coleopterous (Elaterid?) larvæ, which seemed to work entirely independently of the worms, and bored all through the ripening kernels, doing much destruction.

A leaf-miner was found on the vine during June, 1891, but was not bred. It mines the substance from between the two skins of the leaf, and its gallery may be seen plainly, with its small grub at the terminus of it.

On the 15th of June, 1891, I found a rather large number of adults of a Rose Chafer (*Macrodactylus* sp.) on the leaves of the vine in the vineyard about a mile from this place. They had eaten the leaves very badly and were nearly all *in coitu*, but were found on only two or three vines. They soon afterward all disappeared.

A leaf miner on the cottonwoods here (*Populus fremontii*) annually destroys the whole first crop of leaves on nearly every tree in the valley. April 30th, 1891, nearly every cottonwood presented a thoroughly blistered appearance, caused by the inside of almost every leaf on the tree having been entirely eaten out, leaving the blistered-like skins of the leaves alone on the trees. This appearance continued for a couple of weeks until the trees gradually put forth a whole new crop of leaves. The second crop of leaves was but little infested this year, though I am told that in some years they also are nearly destroyed. I was unable to breed this miner.

The vine-leaf hopper has been studied. Eggs deposited singly, last of April, beneath skin of leaf, marked by a minute globule of exuded sap. Hatched last of May or first of June. Kerosene emulsion on the young hoppers, diluted fifteen times, proved effective; I. X. L. compound only partially so.

Owing to a misunderstanding of one of the names in this paper a slight discussion on the habits of *Aleochara* followed.

Mr. Schwarz considered the larvæ of these beetles not to be true parasites, but simply predatory.

Mr. Fletcher had bred larvæ of this genus from puparia of the cabbage maggot, in which no holes of egress or ingress could be discovered, and considered them to be true parasites.

Mr. Schwarz said that Mr. Coquillett had noticed the larvæ of *Aleochara* enter the puparia of *Anthomyia*, and stated, moreover, that the beetle larva has no approach to the parasitic habitus.

Mr. Southwick mentioned the occurrence of mites upon *Scarites subterraneus*.

Mr. Webster mentioned the abundance of *Uropoda americana* at Columbus, on *Diabrotica* and a large number of other insects.

Mr. Alwood and Mr. Atkinson spoke of the abundance of beetle mites in their localities.

NOTES ON BLACKBERRY BORERS AND GALL MAKERS.

BY JOHN B. SMITH, NEW BRUNSWICK, N. J.

Blackberries are raised in New Jersey on a very large scale, and near Hammonton, in Atlantic County, several hundreds of acres are devoted to this fruit. After many trials the "Early Wilson" was selected by growers as the most satisfactory variety for size, flavour, date, and shipping qualities, and it forms the bulk of the crop. A few other

varieties are raised to extend the season; but the "Wilson" is the staple. Unfortunately it adds to its many excellent qualities that of extreme susceptibility to insect attack, and of all the varieties grown in New Jersey this only is killed down in a few years unless carefully looked after.

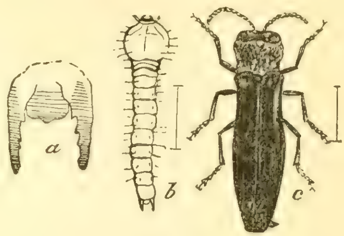

Fig. 10.

I began my studies on the insect pests of the black berry in the early part of the present year, before yet the canes had begun to leaf out, and found that all the pests infested cane or root.

One of the chief pests is the well known *Agrilus ruficollis*, or red-necked blackberry cane borer (Fig. 10). Its life history has been worked out by others, and I have nothing of any importance to add. The well-known galls (Fig. 11) usually indicate the position of the borer, and how to get rid of it is the question. I say the galls *usually* indicate the position of the borer, because, though there can be no gall without a borer, we can have a borer without a gall. If a gall be split the length of the cane it will be seen that the wood is not involved in the gall growth, but only the bark. The insects emerge from the canes in early summer, May 25 to July 10, the month of June being the time of greatest abundance. The egg is laid by the female at the base of a leaf stalk, and I believe it is not thrust into the tissue, but is simply laid at the base of the stalk or in the bud there starting. It was not until late in July that any larvæ were found. The first sign of their presence was a dead bud at the leaf axil, and where the stem was carefully examined almost every dead bud showed traces of having been eaten into, the minute and very slender young larvæ being found under the bark near by.


Fig. 11.

Usually they run up the main shoot; but where laterals have become well developed they often go into these, especially where more than one egg was laid in the same place. In neglected fields, often as many as three eggs may be found at a single point, and five leaf axils may be infested on a single stalk. The young larva bores upwards in a cork screw channel in the sap wood, until early August. Some are at that period only one fourth of an inch long and almost nothing in diameter, while others are half an inch in length and reasonably stout. Sometimes a larva will make only two or three long circles around the cane and then, while yet minute, will pierce the cane and get into the pith. Where this is done, no visible gall forms. Others, however, and usually those in large, stout canes will circle the stalk half a dozen times or more in succession, the girdles not more than one-eighth of an inch apart. The first trace of a gall I found in early August, when a slight ridge appears over every larval gallery, so that the course of the borer is perfectly traceable on a smooth stem. As the cane grows the sawdust and excrement in the galleries seem to swell and enlarge and also to destroy the vitality of the tissues around it, until instead of the girdlings becoming smaller, they really become more prominent, and the abnormal growth of tissue continues. In some cases, as stated, no galls appear; but this is somewhat exceptional. In raspberry I have not found the galls, while borers have been found not rarely. This indicates that some of the exempt varieties of blackberries may simply form no galls. I am the more inclined to believe this, because I have seen beetles in no small numbers in "exempt" fields. I believe, too, that killing the cane is due, not to the injury in the pith, but to the injury done under the bark. Beyond this, the history of the insect is well known; but I am not aware that the gall formation has been as fully observed. Of course the remedy is obvious. Cutting the galls out thoroughly in early spring and burning the cuttings is certain This is already practised by our best fruit growers, and they are not much troubled. Unfortu

nately there are many who seem unable to understand their own interests, and will delay cutting or refuse to burn. Some fields, too, belong to men of other occupations, and as they become unprofitable, they allow them to go to ruin and to become breeding places for all sorts of pests, fungus and insect.

Next in order, and indeed sometimes even worse, is the larva of a Sesiid, probably *Bembecia marginata*, Harr. The eggs of this insect, which I have not yet seen, are laid late in August or in September. The young larva hatches that same fall, and in the following spring is found in canes of the previous year's growth, boring only a short distance up from the roots. It is then less than half an inch long and of a faint reddish tint, which it loses as the summer advances. In July it leaves the cane on which usually no fruit has set, and attacks a new shoot, eating around the base and burrowing up between bark and wood. The shoot wilts, but the larva seems not to travel more until the following spring. It is then an inch long, white in colour, and with a brown head. It eats at the crown until the new shoots are large and vigorous, and early in July the wilting shoot in infested fields indicate the whereabouts of the larvæ. They pupate in August, one pupa newly formed being found on the 10th, and a number on the 23rd, but at these dates no imago was yet noticed. One pupa had wriggled out through the stem at the latter date, apparently ready to transform. The insect is important because it cuts two year's growth of infested hills. The remedy is also mechanical. It consists in cutting the shoots as they wilt close to the crown, and destroying the contained larvæ.

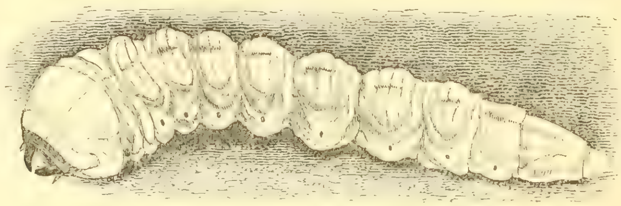

Fig. 12.

Sometimes in June a hill will suddenly wilt and die as if burnt. Search will in all cases reveal an enormous longicorn larva, (Fig. 12) which I make out to be that of *Prionus laticollis* (Fig. 13). In some old fields it is very mischievous, boring huge channels in the main root. I am not aware that this has been heretofore noted as infesting blackberries, and simply record the habit.

Fig. 13.

Another insect infesting growing canes escaped me during the present season because unexpected and unnoticed In cutting some new shoots I found them marked, through the pith from base nearly to tip, a distance of three or four feet, by a larval channel. The new canes had been already topped a first time and I missed the culprit. In some fields not yet topped I found that the borer had emerged or had been parasitized, fragments only remaining, which seemed to prove it Lepidopterous. No apparent damage was done by the insect and none of the bored stems died.

A little gall on young shoots, found very locally only is formed by a *Cecidomyiid* very near to *Lasioptera farinosa*, if not identical with it. The young shoots are always trimmed out before the imago emerges in spring, and no damage is done. The larva is also parasitized quite frequently, and only a few imagos were obtained. The relations of the parasites to each other are still somewhat obscure, and one of the species may be secondary.

AFTERNOON SESSION.

Meeting called to order at 4 p.m. by President Fletcher; 29 persons were present.

THE SQUASH BORER, MELITTIA CUCURBITÆ, AND REMEDIES THEREFOR.

BY JOHN B. SMITH, NEW BRUNSWICK, N. J.

The most dangerous enemy to squash culture in New Jersey is undoubtedly this borer. Its life history is already fairly well known, and the question of remedies is the vital one. Those usually recommended have not proved eminently satisfactory in practice, and cutting out is still most generally relied upon. Summer squashes are badly infested, but have a large stout stem and usually mature a crop before the borers can kill the vine. Of the later varieties the Hubbard is the favorite, not only of the grower but of the borer. The missing links in the life history seemed to be in the egg stage, and these were carefully observed by me during the present season. I found in every case one or more eggs at the base of the plant, as near to the root as possible, and usually on the underside of the stem, *i. e.*, that portion of it resting on the ground. The moth evidently gets as near to the base of the plant as possible, and deposits her eggs as far towards the root as her ovipositor will extend. Rarely the egg will be found at the axil of the first or second leaf stalk; but it is at such points that the insects rest at night. The egg itself is chestnut brown in colour, in form a flattened disk and of quite large size. The shell is quite hard and chitinous, but brittle. It is not readily pervious to the kerosene emulsion diluted 12 times, but is readily crushed. This stage is quite a protracted one, lasting at least 12 and probably often 15 days. The young larva when it leaves the egg moves off less than an inch and immediately enters the stem. This habit accounts for the ill success of the arsenical mixtures applied to the stem. The difficulty of getting all around it is great in the first place, and the larva eats so little that it has at least an even chance for escape. The kerosene emulsion might be more satisfactory but for the difficulty of getting the application on the under side of the stem. When the egg-laying habits were observed the experiment patch was examined, all the spare vines pulled up so as to verify the universal presence of eggs, and then with the fingers the bases of the vines were rubbed thoroughly. This was intended to crush the eggs, and it was effective. The process was twice repeated, and two or three larvæ only escaped. The other vines continued healthy and free to date. Where planting can be deferred to July the vines will be free from borers, and this is the plan adopted by some large growers In small or garden patches, rubbing the stems of the vines near the base will prove effective and is a simple and cheap remedy Planting summer squashes as traps and destroying the vines before the insects mature would also be a good way to avoid injury.

Mr. Riley asked whether Mr. Smith had tried the ordinary method of mounding the vines with ashes.

Mr. Smith said that he had not, and that he thought that this practice would simply oblige the moths to lay their eggs higher up the stalk.

Mr. Alwood said that he had found all cucurbitaceous plants quite resistent against the injurious effects of kerosene, and inasmuch as he had been successful against *Diabrotica* with kerosene emulsion, he thought that this substance would be available against the borer.

NOTE ON A COTTON CUT-WORM.

BY G. F. ATKINSON, AUBURN, ALA.

[Secretary's abstract.]

During the early part of July the author visited Greensboro, Ala., at the request of a cotton planter who complained that great damage was being done to the young cotton by worms. He found that an acre had been entirely stripped and had been plowed under and replanted. He found Noctuid larvæ at the roots of 20 or 30 of the plants, which he subsequently reared to the adult stage and proved to be *Agrotis annexa.* Experiments with Paris green seemed to show that this insect could be treated with this substance. He also found the larvæ feeding on *Amarantus.*

NOTE ON A NEMATODE LEAF DISEASE.

BY G. F. ATKINSON, AUBURN, ALA.

[Secretary's abstract.]

This worm has been found by Dr. Byron D. Halstead affecting the leaves of *Chrysanthemum* and *Coleus* in New Jersey. It makes no swelling or deformity as do many other Anguillulids, but causes a brown patch upon leaves. Mr. Atkinson has determined this as a species of the genus *Aphelenchus.* He entered into some details as to the distinguishing characteristics between Aphelenchus and Tylenchus, and showed that this species is somewhat aberrant in the genus in which he has placed it.

Mr. Smith asked whether the characters of the genitalia are constant.

Mr. Atkinson replied that they are within generic limits, but that they do not differ with species except as regards the distance from the anal end of the body to the genitalia. Mr. Atkinson further stated that he thinks that these Nematodes reach the leaves by being borne up in the axils of the leaves as the plants grow.

Mr. Riley asked whether it was not possible that the young might work their way up the plants to the leaves during rain.

Mr. Atkinson agreed as to the possibility of this method, and further stated that he had received what he supposed to be the *Tylenchus tritici* or *scandens* of Europe, from grass in Colorado.

KEROSENE EMULSION AND PYRETHRUM.

BY C. V. RILEY, WASHINGTON, D. C.

In the *Rural New Yorker* of June 20th, 1891, Dr. Albert E. Menke, director of the Arkansas Experiment Station, criticises a review of Bulletin No. 15 of his station, published in *Insect Life.* The principal point raised by Dr. Menke is that kerosene extract of pyrethrum, made into an emulsion with soap and water, is entirely different from an aqueous extract of pyrethrum made into an emulsion with soap and kerosene, as recommended by Professor Gillette. He also disputes the statement that the idea of combining kerosene and pyrethrum was given him by Prof. Jerome McNeill. Prof. McNeill has experimented with both the Gillette and the Menke combinations, and in a recent communication he confirms the statement that he first suggested the combination of these two substances to Dr. Menke and gives the results of his experience as follows :

In preparing, in accordance with your directions, Dr. Menke's mixture, I used the proportions given in Bulletin No. 15 of the Arkansas Station. The extract of

pyrethrum was made by simply digesting the powder in kerosene for three or four hours. The resulting emulsion is good, and it is about as effective on the Cabbage Worm as he claimed it to be on the Cotton Worm. Mr. Gillette's mixture I made with the same proportion of soap, kerosene and pyrethrum as the first mixture contained. * * * The emulsion was made in the usual manner, and then it was diluted with the kerosene tea. When Dr. Menke's mixture was diluted equally, there was no difference between the two in appearance or odor. In using dilutions of the strength, fewer worms survived the application of Mr. Gillette's solution, but the difference was immaterial, as when I applied the mixture without knowing which I was using, I could not always tell which of the two I had employed. Such in brief are the conclusions I have reached after a considerable number of experiments with the two. I shall not be satisfied, however, without further trial of these mixtures upon different worms. One thing that has disturbed my satisfaction with these experiments is, that in many cases where I had applied a dilution of a given strength to larvæ of different age, the younger larvæ seemed less affected than the older. Concerning the difference between an aqueous extract of pyrethrum made into an emulsion with kerosene and soap, and a kerosene extract of pyrethrum made into an emulsion with soap and water, there is no practical difference. It may be of some slight interest to scientific people to know that the aqueous extract and the kerosene extract are technically different. As far as their use is concerned these two are absolutely one. If there is any practical difference between them, the aqueous extract emulsion is preferable. I have never made any public claim to having originated the idea that kerosene would dissolve the insecticide principle of pyrethrum. What I wanted to announce the discovery of was, that the two insecticides, kerosene and pyrethrum, could be combined in an emulsion which would be more effective than either. When I was assured by Mr. Mally (an agent of the Division) that he had made such a mixture while working with Mr. Gillette, my personal interest in the matter ceased. Dr. Menke claims to have discovered an "entirely new" insecticide which is remarkable for its cheapness. I think I have shown that it is composed of the same materials which may be used in the same proportions, so that the difference between his emulsion and Mr. Gillette's is in method of preparation, and in this respect his method is decidedly the inferior. The chief difficulty in the use of pyrethrum in kerosene emulsion is the cost when compared with the cost of the arsenites in the form of powder or in solution.

* * * * * *

Mr. Smith had tried the kerosene-pyrethrum combination according to Menke's formula, but had found it of no use against the Rose Chafer.

In response to a question by Mr. Smith, Mr. Alwood stated that he buys imported powder for from 38 to 40 cents per pound at wholesale in New York For buhach he has to pay 75 cents per pound and considers that one is as good as the other. He finds that he can keep the powder in bulk for two or three years, with care.

Mr. Webster stated that he could buy it by the 10 or 20 pounds in Lafayette, Ind., at 30 cents per pound.

Mr. Alwood stated that in his opinion this powder must be adulterated on account of the cost of production in Dalmatia.

Mr. Smith buys in Philadelphia for 25 cents per pound.

Mr. Weed had found kerosene combined with pyrethrum perfectly useless against the Harlequin Cabbage Bug. Kerosene emulsion is also ineffective against the same insect.

Mr. Alwood, however, had found it effective for this insect.

Mr. Weed stated that he had killed the plants but not the bugs. He has found the eggs of this insect to hatch in three days in Mississippi (first brood), those of the second brood hatching in two days, and those of the later brood in four days. These periods, however, are not definite, and considerable variation occurs.

Mr. Smith finds this species in southern New Jersey, but never upon cabbages.

Mr. Doran stated that the bugs can be caught upon Mustard before the cabbages are set out.

Mr. Weed said that he had experimented in that direction and recommended the application of pure kerosene upon the first brood of bugs upon Mustard.

Mr. Bronk had traced an attack of this Cabbage Bug from Kale to Cabbage, the Kale having been destroyed and but three plants accidentally left.

Mr. Osborn said that Mr. Gillette conducted his kerosene-pyrethrum experiments nearly a year before his results were published, awaiting confirmative evidence.

Mr. Riley said that the great efficacy claimed for these combinations of Mr. Menke and Mr. Gillette will not be borne out by further experiment. Against the Boll Worm his agents have not found them thorough antidotes.

The association then adjourned.

AUGUST 18, MORNING SESSION.

The Association was called to order by President Fletcher at 9.30 a.m. Thirty-four persons were present. The minutes of Monday's meeting were read and approved. On motion, a nominating committee, consisting of Messrs. Howard, Weed, and Bruner, was appointed.

WORK OF THE SEASON IN MISSISSIPPI.

BY H. E. WEED, AGRICULTURAL COLLEGE, MISSISSIPPI.

[Secretary's abstract.]

There has been no one great outbreak the present season. Last year stock was injured by the Screw Worm quite extensively, but the planters are now treating with carbolic acid washes and are lessening the damage. The Cotton Leaf-worm and the Boll Worm are the principal insect enemies of the State. The former is only just appearing and will not be destructive. The Boll Worm was injurious last fall owing to wet weather. *Ægeria pyri* occurs abundantly in apple trees, but not in pear. *Hippodamia convergens* (Fig. 14) he has proven to be an injurious insect, as he has seen it feeding upon the leaves of cabbage. Moreover, he has poisoned with Paris green and killed the beetles. The Chinch Bug occurs in the western part of the State on corn. The cabbage crop is almort invariably destroyed by the Harlequin Bug and other insects The Plum Curculio is very abundant upon peaches.

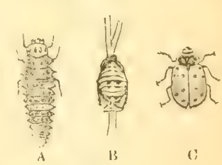

Fig. 14.

Cattle Ticks (*Ixodes bovis*) are very abundant in the southern part of the State. The emedy in use is to feed the cattle equal parts of sulphur and salt continuously.

The question of the action of the sulphur was brought up by Mr. Fletcher and Mr. Marlatt, and Dr. Marx stated that the sulphur was eliminated by the sudoriferous glands, thus bringing it into contact with the ticks.

Mr. Smith considered Mr. Weed's experiments with Paris green against *Hippodamia convergens* not conclusive as indicating their phytophagic habit, as the beetles might have been feeding upon plant lice and thus have been poisoned by the Paris green.

Mr. Popenoe stated that he had found *Hippodamia* feeding upon rust spores.

Mr. Weed described the treatment of Cotton for the Cotton Worm by means of a long pole carried across a mule's back with a bag of Paris green hanging to each end of the pole. In this way four rows of Cotton can be treated at once with undiluted Paris green.

Mr. Webster stated that in Louisiana four sacks were thus strung upon a single pole.

NOTE ON THE HORN FLY IN OHIO.

BY D. S. KELLICOTT, COLUMBUS, OHIO.

Since the full accounts of the Horn Fly given in *Insect Life* and elsewhere, I, as many others, doubtless, have sought for it wherever I had an opportunity. I remember no reports of its occuring west of the Atlantic border, but it certainly has a foothold in central Ohio. During the first week of July last I found it in great numbers on the farm of Mr. A. Freed, Pleasant Township, Fairfield County. Large patches were seen on the backs and about the horns. The animals referred to had been dehorned, but the fly, true to its instincts, congregated about the stumps. At Sugar Grove, 8 miles south, a few were found, whilst at Rockbridge, 4 miles farther down the Hocking Valley, none were to be found. There appears to be none north of the first-named station, as I had a fair opportunity to examine cattle at Lakeside (Licking reservoir). They have not been seen at Columbus. It seems from the limited observations I have been able to make that it is spreading southward from near Lancaster. The Baltimore and Ohio Railway passes but a short distance north of this place, and it is easy to see that it is possible, or indeed probable, that it was introduced by transportation in cattle cars from the East.

Mr. Smith stated that the Horn Fly was not injurious in any part of New Jersey last year, stockmen adopting the plan of spraying with fish-oil compound. He also stated that the plastering of the dung was practised in his State in small stock yards.

Mr. Howard said that even in large grazing fields this latter plan is often practicable in spite of the objections which stock-growers urge. At the time when the flies are ovipositing the cattle are generally congregated in some one spot for shade.

Mr Lintner said that he heard of the fly in the southeastern portion of New York State.

Mr. Osborn said that there had been an unverified report of its occurrence in Iowa. He believes that the plaster treatment of the dung will be practicable in his State.

Mr. Fletcher said that many remedies which are considered impracticable by farmers prove eventually to be very practicable, and he instanced the poisoned ball system for cut worms, and said that standing grain can be sprayed with knapsack pumps.

NOTES OF THE SEASON.

BY ELEANOR A. ORMEROD, ST. ALBANS, ENGLAND.

The Secretary then read the following, which was addressed to the President, Mr. Fletcher:

You pay me the compliment of suggesting that I should send a short report of my entomological work of this year up to present date. But though it would indeed be a gratification to me if anything I could mention should be thought of interest, yet I feel such a hesitation in submitting anything I can say to such a supremely well skilled tribunal as that of the meeting of the Association of Economic Entomologists at Washington, that I will rather endeavour to give, in letter form to yourself, some notes of what we have been doing, from which, if you judge fit, you could lay some points, with my best respects, before the meeting.

Paris green.—I think that I may now report the use of Paris green in fluid state (as a remedy for attacks of orchard caterpillars) as having thoroughly taken root in this country. It is not yet as widely spread as could be wished, but the very large amount of inquiry sent me during the spring and summer months as to the nature and method of application of the remedy gives me good hope that its use is extending.

We have nearly, if not entirely, overcome the clamour as to the use of a "deadly poison," and now I have rather to attend to the other side of the question and warn as to the necessities of care.

My correspondents are not without a sort of dry jocoseness in the matter, for having cautioned one inquirer that if he sprayed his gooseberries he had better have a large gooseberry pie made and *consumed* by himself and household as a proof that all was right, I presently received a donation of as fine green gooseberries as could be desired. Did he wish to transfer the experiment, I wonder? About effect of Paris green on leafage, one of my correspondents reports to me that in his plum garden (32 acres) he syringed twice with Paris green at a strengh of 1 ounce to 10 gallons, using the "Gelair" sprayer. He did not begin until the plum blossoms fell, and had to syringe twice because of the badness of the attack, also because rain came. The syringing was very carefully done so that there was no observable dropping from the leaves, and on the 10th instant he wrote me: "I have an extraordinary crop of plums in consequence."

With regard to foliage of the sprayed trees, he says:

I find that the Pershore Egg Plum, Victoria, and Damsons, have their foliage quite uninjured and looking very healthy: but Czar and Rivers Early Prolific are decidedly injured, and New Orleans in a lesser degree. These are all the varieties I grow. Evidently some varieties of plums are much more easily injured than others by Paris green. (I.R.)

I hope, before preparing my next annual report, to obtain detailed information on this subject from various quarters, but I think the further observation of my correspondent (M. J. Riley, of Putley Court, W. Ledbury) well worth attention *here* until *we* are more experienced.

I syringed 60 acres of apple trees which were badly attacked by caterpillars, 1 ounce to 20 gallons, which seemed to kill the caterpillars, so that one naturally asks, why make it any stronger for plums? (I. R.)

But I find difficulty in persuading people to be moderate, as they desire a strong spraying to do all the work at once.

M. J. Riley further notes, relatively to effect of method of spraying, that last year (before we could procure proper sprayers) he had only common garden syringes; that he syringed "Damascenes," badly infested, with the same strength of Paris green now used with success on several kinds of plums, namely, 1 ounce to 10 gallons, and too much being put on so that the trees dripped, the lower branches were killed.

After our real difficulties, and the boundless and fathomless amount of damage and trouble predicted last year, it is a very great satisfaction to me to have trustworthy reports of the excellent state of foliage of trees properly sprayed last year, and also to find the greatly lessened amount of caterpillar presence which occurs compared to previous appearances where Paris green applications or banding have been *properly* attended to.

But I should be ungrateful and fail in proper thankfulness if I did not acknowledge that, for this benefit to British fruit-growers from the use of Paris green, we are indebted, I believe, primarily, to the exertions of our respected friend, now holding the distinguished office of Entomologist of the Department of Agriculture of the United States of America, and likewise to the careful working forward of the subject both in the United States of America and Canada, and for myself I am bound to say (and I hope you will permit me to acknowledge) that but for the efficient and kind help you were good enough to give myself and our Gresham committee, I greatly doubt if we could have pushed the subject to its present well-based standing.

Our Gresham fruit committee is doing good work by the investigation of the members being extended to all our noticeable injurious fruit attacks which they discover to be present. These are entered on at their meetings. Where the insect pest is unknown to them they forward it to me and I identify (or procure its identification) for them, and with the addition of their practical observations of life history, and means of prevention and remedy, added to what we find recorded, we make serviceable advance.

It would be very advantageous if we had more such committees, for the work is so

very *real.* No make believe or fanciful remedies gain the stated formal approval of a body of experienced fruit-growers whose returns depend on the treatment of their crops.

This year we have been working up for one thing, the Raspberry Beetle, *Byturus tomentosus*, Fab., which Mr. C. D. Wise finds at the Toddington fruit grounds may be best got rid of by shaking down into bags moistened or sprinkled with paraffin.

The Raspberry Bug Caterpillar of the *Lampronia rubiella*, Bjerk., has also been greatly troubling raspberry growers by its injury to the young buds and sometimes in the canes. We hope by gathering the infested buds or neighbouring bunches of leaves in which the larva has pupated, and destroying these, to have forestalled much recurrence of next year's attack.

Plum Saw-fly has also made a slight, and Apple Saw-fly a very decidedly injurious appearance. I conjecture that the similarity (to general inspection) of the attack of the latter to that of the Codling Moth Caterpillar has caused it not to be generally noticed before, and I hope to be able to add some notes on the changes in appearance of the larvæ. In all respects of habits and appearance preceding pupation this Saw-fly larva agrees with such descriptions as I have access to of that of the *Tenthredo testudinea*, Klug (=*Hoplocampa testudinea*, Klug), but *previously* I find that instead of the head being tawny or pale chestnut, and little trace of colour above the caudal extremity, that the head is pitchy black, and there is also a pitchy black plate above the tail preceded by a cross band and a few small markings also pitchy or black.

We have traced this change by the observer (Mr. Wm. Coleman, of Cranfield, Beds.) watching specimens for me in natural conditions through their transformations. I think that if this change has not been noted it will be of serviceable interest to record it, as on first glance the variously marked larvæ appear to be of different species.

For prevention of recurrence of this attack I am suggesting lightly shaking infested trees over cloths sprinkled with some mineral oil, so that the caterpillars which are very fairly active should not escape. Plum Saw-fly has been only reported from one locality.

The bud-galls on Black Currant caused by the *Phytoptus ribis* or Black Currant Gall Mite have been present to a seriously destructive extent. We know of no remedy for this attack excepting use of soft soap and sulphur wash, or, as a preventive of spread, breaking off the bud-galls. We, however, have found this year that parasites are at work in the persons of Chalcids, which we have not yet identified specifically, and from some small amount of further observation I venture to hope that we may find a dipterous larva is also aiding us in preventive service.

I fear these simple matters may not be worth your attention, but I just mention them as a part of the work to which our fruit growers are giving careful attention.

The field crop insects pests have been very prevalent this year, and at this time we have just begun a heavy visitation at three places in the east of England of the larvæ of the *Plutella cruciferarum*, Zell (Diamond-back Moth as we call it). But I ought not to venture to intrude on your time more than with just two further observations.

One, that I find the distorted growth of heads of Tares (*Vicia sativa*) which I drew attention to in my fourteenth report is originated by the presence of Cecidomyiid larvæ. I found them present in large numbers, and have carefully figured the head and caudal extremity and likewise the anchor process, which agrees so minutely with that of *Cecidomyia leguminicola*, Lintner, that I am looking forward with impatience to the development of the imago. My special colleague in observation of this attack (Mr. A. Hamlin of Chellowes Park, Lingfield), has planned an arrangement in the open field by which the imagos when they rise from the soil will (according to all ordinary habits of insect procedure) be safely trapped conveniently for examinatlon. I am sparing no pains also myself to develop the imagos, though I have not the opportunity to attempt to rear the larvæ in absolutely natural and undisturbed circumstances.

My other observation is regarding the *Hypoderma bovis*, the Warble Fly. We are still fighting ignorance and idleness and downwright knavery, which are the supports of

continuance of this attack; but I had the great satisfaction this summer of hearing from Mr. Bailey, the head master of the Aldersey Grammar School, Bunbury, Tarporly, Cheshire, that it was not worth while to give me a detailed report again this year, as for all practical purposes the attack was now stamped out in the district.

This gratifies me exceedingly. Some six or eight years ago, Warbles were described "as plentiful as blackberries" in the district, and, under the teaching of their admirably intelligent master, the boys, who are mainly sons of farmers and agricultural laborers, set themselves yearly to clear all the cattle they had acccess to of the maggots. I had yearly detailed reports of quantity killed, and now I can point to the district and to the satisfaction of the cattle owners as a proot of what can be done by the simplest hands where head and heart go to the work.

But now I ought not to add another word, and if there is anything in the foregoing pages which you think worthy of bringing before the distinguished Entomological meeting at Washington, it will be a great gratification to me. I should like much to be present myself, with the double pleasure of seeing many whom I know by their letters are kind friends to myself, and also learning much that would be of enormous benefit to me. (Torrington House, St. Albans, England, July 20, 1891.)

Mr. Southwick moved a vote of thanks to Miss Ormerod for her excellent paper. Adopted.

Mr. Osborn spoke of the great value of Miss Ormerod's work against the Warble Fly as showing how combination among workers can bring about almost entire immunity from this pest. Miss Ormerod's plan should be adopted in this country.

Mr. Fletcher also spoke highly of Miss Ormerod's work in this investigation.

Mr. Marlatt, however, stated that the plan of gathering the bots from the backs of cattle can only be practised in the East, where the cattle are domestic, and will not pay for the trouble in the West, where the cattle are wild and would have to be roped and thrown.

Mr. Fletcher thought, however, that the saving of hide value alone would pay for this trouble.

Mr. Southwick thought that it would be a very easy matter to rope and throw the cattle in the West, and considered that it would pay.

Mr. Osborn called attention to the fact that the majority of Western cattle are sent East and slaughtered so that the bots have no chance of maturing. He insisted upon the ease of stamping this pest out in restricted localities in this manner, since the flies do not migrate to any extent.

Mr. Kellicott stated that he had known the Warble Fly to be very bad in Oswego County, New York.

Mr. Lintner stated that it is not a general pest in New York State, but occasionally a local one. Mr. Lintner further stated that Miss Ormerod has proven the Plum to be less susceptible to the arsenites in England than the Apple—a remarkable fact and not at all in accordance with our experience in this country. This difference probably depends upon climate and upon difference in varieties.

Mr. Southwick suggested the reference of this question to the botanists.

Mr. Fletcher stated that the different varieties of plums show with him great difference in susceptibility to this treatment. He spoke of the great variation in the texture of the leaf and in other particulars in the varieties of plums. Much work must be done in this direction. He also mentioned the great susceptibility of the peach.

Mr. Alwood mentioned the fact that the addition of lime water to the arsenical mixture absolutely prevents the burning of the foliage.

Mr. Cook had found the Bot-fly attack much less in cleared farms than in wooded ones. In regard to the arsenites, he said that an abundance of Aphids and consequent weakening of the vitality of the tree might make it more susceptible.

Mr. Smith suggested that the water referred to by Miss Ormerod might contain lime salts so as to make the application more innocuous. He stated that the chemical reasons for the prevention of injury to foliage by the addition of lime water are given in the appendix to his annual report of the present year.

NOTES ON THE RECENT OUTBREAK OF DISSOSTEIRA LONGIPENNIS.

BY E. A. POPENOE, MANHATTAN, KANS.

[Secretary's abstract.]

July 10 to 19 the author visited the northern part of Lincoln County, Colo., on account of newspaper reports of the stopping of trains by grasshoppers. He found a strip of country 16 by 25 or 30 miles in extent fairly covered with locusts, which proved to be *Dissosteira longipennis*, a western isotype of the eastern *D. carolina.* They were congregated especially in the boundaries of this area. The country is poor, and planted here and there to corn and sorghum, and there are occasional patches of garden vegetation. The season has been favourable and cool. The locusts are said to have come in swarms from the South last fall, and to have settled along the Big Sandy Creek in a patch two or three miles in circumference, in which they laid their eggs in great numbers. Upon hatching this spring the young spread outwards. At the time of his visit in the northern part of the strip the insects were in the last larval and pupal stages, with very few imagos. At the south line, however, the winged individuals were very abundant and flew like birds. The young hoppers had the habit of crawling up the side of buildings for a few feet, presumably for warmth They were not strictly confined to roads, but travelled over bluffs and rounded hills, eating the buffalo and gramma grass. The winged individuals flew always to the south, but the others spread regularly outwards in all directions. The line of march was quite visible at some distance on the hillsides, and sheep-growers had to change the localities of their flocks In marching, as a general thing, they preferred to follow the roads, moving quite rapidly, about one mile in six hours for six or eight hours in a day only. They are credited with all the destruction which has been done by all kinds of insects, and he thinks that they did but very little damage to potatoes and corn, although marching through the fields in great numbers. At the time of his visit they were marching through wheat fields in the same way, but since he left they have done some damage to this crop. Many dead ones were noticed in one locality, but no signs of parasitism were found. It is supposed that they were destroyed by hail. In his opinion the insect occurs generally upon low ground rather than upon high ground.

Mr. Bruner said that this species is very seldom found below 3,000 feet, or above 5,500 feet elevation. It occurs in Nebraska, Kansas, Colorado, Wyoming and north-eastern New Mexico. It preferably locates itself on the side of the hills or the upper portion of slopes where the vegetation is scattered. Its near ally, *D. carolina*, is found throughout North America following civilization in cattle yards, roads, and streets. He had also seen the dead locusts in one locality in eastern Colorado, and considered that they had been killed by hail.

Mr. Popenoe said that he had really found that they had stopped trains, but upon steep grades only and by greasing the rails.

Mr. Osborn has found this species in southwestern Kansas in the higher portions of of river valleys and feeding upon the grass along the roads.

NOTES ON A CORN CRAMBID.

BY M. H. BECKWITH, NEWARK, DEL.

[Secretary's abstract.]

For three years the author had heard complaints in the southern counties of Delaware of an insect called by the people a "Cutworm." This year at the Experiment Farm at Dover many hills were destroyed by this insect which he had had an opportunity to study. The land was in timothy last year and planted to corn the present season. Large numbers of the larvæ were found, sometimes thirty in a hill, working around the outside of the stalk below the surface of the ground in silken galleries, but not boring into the heart of the stock. He had sent specimens of the moth which he reared to the Department of Agriculture and it had been determined for him as *Crambus caliginosellus.* He had tried Paris green, but does not know with what effect.

Mr. Smith had heard of a similar attack on corn in New Jesery. He advised the farmers to put on a heavy dose of kainit just after plowing and had heard no more complaints.

Mr. Osborn suggested that if the insect works like *Crambus exsiccatus* plowing at the right time will prove affective.

Mr. Howard said that the insect was abundant in 1886 at Bennings, Md., and that the only remedy which he was able to suggest at that time was plowing immediately after harvest.

Mr. Alwood doubted whether kainit would act as well as the refuse salt from meat-packing establishments, which he had found to be a good cut-worm remedy if sowed before planting.

Mr. Smith recommended kainit because it is a fertilizer as well as an insecticide.

Mr. Alwood stated that kainit is a bad form of potash for tomatoes and potatoes.

Mr. Southwick said that his grandfather used to drop a salt herring into each corn hill as a preventive against Cutworms.

Mr. Beckwith said that he had applied a fertilizer and salt in Delaware for cabbage and thus prevented Cutworms, as he proved by a check experiment.

Mr. Alwood uses tobacco also in fertilizers as insecticides.

NOTES OF THE YEAR IN NEW JERSEY.

BY JOHN B. SMITH.

During the spring of 1890 the larvæ of the Clover-leaf Beetle, *Phytonomus punctatus*, appeared in great numbers and threatened to become seriously destructive. A fungoid disease opportunely attacking them, the vast majority were killed off before they were more than half-grown. Some few escaped, however, and the threat of injury was repeated during the spring of 1891. The numbers were not so great, however, and the fungus disease stepped in as before, destroying the larvæ before they had done serious injury.

Complaints of twig blight in apple were made early in the season, and on investigation two coleopterous insects were found to be concerned in it. One of these, the larva of *Eupogonius tomentosus*, bored through the centre of the new wood, or rather that

made during the previous year, and killed the twig. The beetles appeared in June. The other was a small Scolytid, probably *Hypothenemus*, which made short galleries in the extreme tip of the twigs infested by the Longicorn larva. It is probable that this attack is secondary, and not made while the wood was sound.

Some discussion was had at our last meeting concerning the points of the tree attacked by the larva of *Saperda candida.* (Fig. 15.) This led me to observe carefully during the present season, and I find that while in quince the attack is almost exclusively at the base of the tree, in apple and pear, any part of the trunk and even the larger branches may be attacked. The larvæ are more numerous at the base, as a rule, but the other localities are not by any means exceptional. I know that no other larvæ were concerned, because I cut out pupæ and imagos as well, and am certain of my facts.

Fig. 15.

Peach borers, the larvæ of *Sannina exitiosa* (Fig. 16), are now largely treated by mechanical coatings to the trunk. The favourite means is the one recommended by me in the bulletins of the station and at farmers' meetings. It is simply a thick whitewash with Paris green and glue added. I have never discouraged the use of other mechanical coatings, but have taken great pains to explain that no remedial results must be expected; that the measure was protective merely. The use of paint, as suggested by Mr. Alwood, does not find favour, owing to a fear that injury may result to the tree.

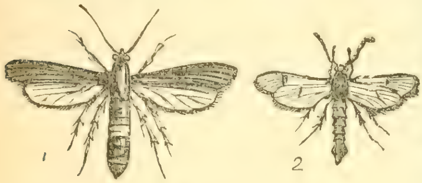

Fig. 16.

Blackberry insects have been particularly observed; but as I have already described these, a mere mention here is all that is needed.

The Rose-chafer, *Macrodactylus subspinosus*, has been less destructive than usual. My studies on this insect have appeared in bulletin form, and I need only emphasize here that all my tests of remedial measures were made in the field under ordinary field conditions, and that the results are such as would likely be obtained by a farmer employing them.

The Grape Flea-beetle made its appearance very early in the year, before even the leaves had made their appearance, and began eating the buds. I recommended collecting in kerosene pans early in the day, and this proved effective. About a pint of the beetles were sent me in grateful acknowledgment.

Root maggots have been very abundant, and onions have been most severely attacked. In some places the young sets have been completely destroyed. This pest is now pretty well distributed in the trucking districts around Philadelphia.

Aphides on orchard fruits, and particularly on apple, became very abundant during a three weeks drought near New Brunswick, and blackened tips everywhere caused serious alarm. A cold storm, lasting two days, broke the drought, and apparently checked the multiplication of the species. There was no further increase of injury, at any rate, and no other complaints reached me.

The melon vines have suffered greatly from attacks of Aphides, but still more from a bacterial disease. The damage done by the latter is quite usually attributed to the Aphides.

I have made some study of squash insects, more particularly of the "Borer" *Mellittia ceto*, of which I have previously spoken. The Stripped Beetle, *Diabrotica vittata*, does not bother our large growers very much. When they seem abundant, they use lime or plaster on a day when there is a gentle wind, sowing it on broadcast. The beetles fly before it and are driven off the field. The next man takes up the work on his field, and so the beetles are driven off until they reach some unguarded field which is then usually injured quite seriously. *Epilachna borealis* has been very abundant, and

has eaten characteristic patches at the edges of the leaves. The insects made their appearance as soon as the squashes were well up, but did not begin mating or ovipositing until the middle of July. Larvæ were not found until August. This gives quite a long period for the mature insect. It is easily kept in check by the use of the arsenites.

The Corn Bill-bug, *Sphenophorus sculptilis*, appeared in large numbers in Burlington, Salem, and Gloucester Counties, and perhaps in other surrounding regions. The beetle drilled the characteristic holes in the young plants at or near the surface and thus destroyed many acres of corn. I advised replanting after a short delay, and the second crop of plants was undisturbed. The insect was a new one to growers, and its appearance in such numbers caused consternation. They were most numerous on old sod, but by no means confined to such land.

Diplosis pyrivora has been complained of as an injurious species for the first time. It has reached Newark, Montclair, Elizabeth, and Paterson, so far as my information extends, and has probably been in some orchards for at least three years. Where it first made its start in this State I have been unable to ascertain. The Lawrence pear is the one most generally attacked, in one orchard over 90 per cent. of the fruit being infested. From an examination of the infested fruit I believe the egg is laid in the ovary, or if not that, the young larva does not pierce the fruit, but follows the pistil into the ovary or seed chamber, the opening in this variety of pear being quite wide. In many cases also this same passage is used by the larva to leave the fruit where it remains sound and does not crack. This promises to be one of the most dangerous of the fruit pests.

Spraying fruit trees with London purple has been very generally practised in New Jersey, and always with most gratifying results. An unexpected result has been the destruction of the fungus on the pear which so generally disfigures varieties like the Bartlett. Fruit on sprayed trees is fine and clean, that on the others is spotted and clouded and of an inferior grade.

The Plum curculio has made a plum crop almost impossible in New Jersey. I made only one experiment myself during the season, spraying one tree with the kerosene emulsion, 1 to 12, once a week for six weeks. At the end of that period nearly every plum on the tree had from one to six larvæ, and I called the experiment a failure. Several growers who had a few trees only report a favourable result in spraying with the arsenites, and there seems little doubt but that a certain percentage of fruit can be saved in this way. For small trees of choice varieties I suggested cutting out the egg. This was done in a few cases with absolute success. It leaves only a trifling scar, no more than that of the original puncture, and is certain in effect. Of course this would not answer on a commercial scale, but for choice fruit in the garden it is not impractical, and might be used to supplement spraying with arsenites.

I have followed out my inquiries into the action of certain fertilizers as insecticides, and am more than ever convinced that in kainit we have a powerful agent for the destruction of forms infesting sod-land. Where this material is used before planting corn even on old sod, cutworms and wireworms will do no injury. In addition, I always advise fall plowing to give the winter a chance. Direct experiments in the laboratory show that Elater larvæ will die in soil that contains kainit, though it acts slowly and two weeks are required to produce a complete result. The experiments will be given in detail elsewhere.

Mr. Alwood, in discussing, said that he had recommended London purple against *Fusicladium* for some years.

GOVERNMENT WORK AND THE PATENT OFFICE.

BY C. V. RILEY, WASHINGTON, D.C.

[Author's Abstract.]

The paper was based on a patent recently obtained by three parties in California for the treatment of trees by hydrocyanic acid gas for the destruction of scale-insects and other insects that injuriously affect trees. It reviewed at length the efforts of the Department in this line of investigation, and showed conclusively that this gas treatment had originated and been perfected by one of the agents of the Division of Entomology, who had, in fact, for the past five years, been carrying on a series of experiments in this particular line under the author's direction; that so soon as the treatment came to be recognised as of the greatest utility and perfected so that it was cheap and available to all needing to use it, application for a patent was made by the parties in question, and, in spite of an official protest from the Department of Agriculture pending the application, a patent was finally granted, as, under the law, the Commissioner of Patents has no right to consider *ex parte* testimony pending examination, even though offered by an officer of the Government in the interest of the public. The fact that the process had been fully described and recorded in official reports from the Department of Agriculture did not prevent the issuing of the patent. So valuable is this treatment considered that an effort has been made in southern California to subscribe the sum of $10,000 to buy the right from the patentees. The author remarked that he personally had no hesitation in advising the orange-growers to pay no heed to the claims of the patentees, and that it would be wiser to combine to oppose them if suit were brought than to subscribe to give them an undeserved and valuable royalty.

His own conviction was that the patent was invalid and the certificate but a piece of paper carrying no absolute evidence of priority of invention; and it is greatly to be regretted that, through legal technicality or otherwise, it should ever have been granted.

The author mentioned other cases of this kind where, after years of labour and large expenditures on the part of the Department of Agriculture, valuable results had been obtained. In some cases they took the form of mechanisms, which were described and figured in the official reports; in other cases of mere discoveries. He said:

"There is nothing more discouraging to an officer of the Government engaged in original investigations, with a view to benefiting the public, than the efforts of various private individuals to appropriate the results, of which the foregoing case is an example. I have been engaged now for nearly a quarter of a century either as a State or Government officer in investigations, having for their object in the main the protection of plants and domestic animals from the attacks of injurious insects. Either directly or with the aid of assistants these investigation have resulted in some important discoveries of universal application, and I can say with pride that, though often urged to take personal advantage of such discoveries, I have in no single instance accepted a fee for information given, or received a dollar from any application of these discoveries, even where others have reaped fortunes. As a salaried officer my duty was plain, and I make the statement, without boastfulness and simply to emphasise the discouraging fact, that in every instance where the benefit to the public has been great, either the honour has been contested by private parties or else means have been taken by private individuals to control, through patent or otherwise, the discoveries for their personal ends."

It would seem that on this account the Patent Office should endeavour, in considering applications for patents for objects which the Government is already endeavouring to accomplish, to ascertain fully what the Government has done, as any other course will tend to pervert, discourage and neutralize all honest efforts made by other Departments of the Government for the public good. It would seem, also, that there is need of some modification of the law in so far as Government evidence is concerned.

Mr. B. P. Mann said that no patent can be held valid unless held by the inventor. The Government ought to get out a patent on the broad invention, and it could then prevent the present holders of the patent from using it.

Mr. Riley and Mr. Mann further discussed the subject.

The president announced that a reception, to which all were invited, would be held at Mr. Riley's residence, Sunbury, Wyoming avenue, at 7 o'clock this evening.

The meeting then adjourned.

AFTERNOON SESSION.

The meeting was called to order at 2.30 p.m. by President Fletcher. Twenty-eight persons were present. The minutes of the preceding session were read and approved. The committee on nominations reported the following nominations for the ensuing year :

For president, J. A. Lintner, of New York.

For first vice-president, S. A. Forbes, of Illinois.

For second vice-president, J. H. Comstock, of New York.

For secretary, F. M. Webster, of Ohio.

On motion, the report of the committee was adopted, the committee was discharged, and the officers named were declared elected. The name of George H. Hudson, of Plattsburg, New York, was presented by Mr. Lintner ; that of H. A. Morgan, of Louisiana, by Mr. Weed ; that of B. P. Mann, of the District of Columbia, by Mr. Bruner, and that of Miss M. E. Murtfeldt, of Missouri, by Mr. Riley. All of these names were ordered to be inscribed upon the roll of members.

On motion of Mr. Howard, seconded by Mr. Smith, it was resolved that the next meeting of the society be held at the place of, and two days preceding, the next meeting of the American Association for the Advancement of Science.

Mr. Riley read a paper entitled "*Dermestes vulpinus* and Tobacco," which is held for publication elsewhere.

Mr. Southwick stated that he had found *Dermestes* under the bark of a mahogany log in New York, and that it had entered this crevice for pupation after having originally fed upon some animal matter.

A NOTE ON PARASITES.

BY L. O. HOWARD, WASHINGTON, D. C.

The object of this brief note is to impress upon the members of this Association the fact that one cannot be too careful in statements for publication concerning the relation between a given parasite and its host.

The possibilities for error are very great, as a few instances will show.

In 1882, while studying the Army Worm at Huntsville, Ala., I noticed an Ichneumonid walking about a fence-rail over which the worms were swarming in countless numbers. The parasite was apparently excited, walked and flew from one part to another, occasionally lighted upon a caterpillar and brought her ovipositor into position. I captured her, and in my notes wrote "Found ovipositing upon the larva of *Leucania unipuncta.*" Now it transpires that this Ichneumonid was *Bassus scutellatus*, and as the consensus of rearing experiments shows, the species of this genus are parasites of Diptera, and my inference was in all probability entirely mistaken. If the original observation had been published it would have been absolutely necessary for perfect safety to have detailed the circumstances in order that future students should not be misled.

Recently a well-known entomologist sent to Professor Riley specimens of the common *Pteromalus puparum* with the record "Reared from the cells of a mud-wasp." From what we know of the habits of this parasite we may take it for granted that had the entomologist in question examined the cells of his mud-wasp he would have found specimens of some lepidopterous larva or pupa stored up as food for the young of the wasp and that from these stored-up insects the parasite had emerged.

Within the last few weeks specimens of a Chalcidid were received from a most careful observer and excellent collector, with the statement that they were reared from the eggs of a saw-fly deposited in a willow leaf. While I am not in the habit of discrediting any statement which this gentleman makes, and while I have learned by experience that his accuracy is something astonishing in this world of error, the fact remains that this parasite is plainly from the known habits of its near relatives an enemy of some lepidopterous or dipterous leaf miner, and that never under any circumstances would it have been an egg parasite. He had probably put his willow leaf in a pill box and had later found the parasites in the box. He did not examine the leaf carefully for traces of a leaf miner or he would never have sent in the record.

Where the parasite is reared from a gall or from a twig burrowed by some other insect it often happens that it is assumed to be parasitic upon the gall maker or upon the most abundant twig borer. Such an assumption should never be made without a complete statement of the facts and without the most careful examination of gall and twig, to see whether they were not inhabited by other insects either as inquilines or parasites, or in the case of twigs as perhaps unnoticed borers.

Instances like these might be multiplied, but this will suffice to indicate the absolute necessity, first, of extreme care in forming conclusions, second, of detailing all circumstances which may possibly have led to error. It is only by such careful work as this that we can ever arrive at proper conclusions concerning the group habits of parasites. Our present published records are full of errors and require a most careful sifting of evidence, which in many instances can no longer be obtained. The most heterogeneous and unlikely errors in many genera are published, and the discriminating work is of extremely slow accomplishment.

Mr. Fletcher stated that he had seen an Ichneumon ovipositing upon a glume of wheat upon which there was no insect.

Mr. Doran stated that he had reared a parasite from *Bruchus scutellaris*.

Mr. Howard stated that this parasite was probably an undescribed species of Mr. Ashmead's genus *Bruchophagus*.

REPORT OF A TRIP TO KANSAS TO INVESTIGATE REPORTED DAMAGES FROM GRASSHOPPERS.

BY HERBERT OSBORN, AMES, IOWA.

In accordance with instructions received July 24, to visit and report on grasshopper injury in western Kansas I started the following morning for Kansas and improved every opportunity on the way to learn of grasshopper injury. The following account is in advance of a report prepared for Dr. Riley. At Des Moines, where I waited a few hours for the Kansas City train, I went through a large number of Kansas papers, kindly placed at my service in the office of the State Register and Iowa Homestead, without, however, getting any information except assertions in some places that there were no hoppers in Kansas.

From a gentleman lately through Arizona, I learned of the appearance of considerable numbers in that Territory, and the expectation that these might be travelling east-

ward. At Kansas City I was equally unsuccessful, the only information received there being the statement of railroad men as to the occurrence of hoppers on the railroad in Colorado (the case investigated by Professors Snow and Popenoe), and of some in Arizona, along the line of the Atchison, Topeka and Santa Fe Railroad.

At Topeka I went first to the office of the State Board of Agriculture. The Secretary, Mr. Mohler, was absent, but the gentlemen present, Messrs. Longshore and Niswander, kindly gave me a full statement as to the information the office contained.

They receive reports from over 600 correspondents who are scattered over the entire State, the western portion being well represented. They assured me that not a single report had been received by them which mentioned injury from grasshoppers, and they were positive that no damage was being done.

At the newspaper offices I received similar replies, except that in the office of the *Kansas Democrat* I learned of a report that some damage had been done in Kearney County. As this report, however, was somewhat indefinite, I hesitated to make it the basis of a special trip to the extreme southwest part of the State, and Lawrence being so near at hand, I concluded to go there to see if Professor Snow had any recent information.

Professor Snow was absent, but his assistant, Mr. V. L. Kellogg, kindly gave me all the information he could. He said that they had heard nothing from the region that had been examined by Professors Snow and Popenoe in Colorado except that the winged insects were moving south, and he was sure that none of these had entered Kansas.

He also informed me that they had received information of injuries at Garden City, and showed me specimens of *Caloptenus differentialis* and *bivittatus* received from there.

This information tending to substantiate the report of damage in Kearney County, I decided to visit Garden City, and took the first train for that place. On the way I kept careful outlook for any signs of damage, and improved the opportunity of occasional stops to collect specimens and inquire of residents as to the prevalence of grasshoppers. All answers agreed in denial of any unusual numbers of grasshoppers or of injury from them, and it was not till I reached Garden City that I learned of any damage. Here I was told that the alfalfa fields were being ruined, and it was only a short time after my arrival that I was in a field a mile from town where the conditions showed at once the state of affairs to be serious.

The alfalfa was badly stripped, the blossoms and seed entirely eaten up, and in many patches the stems were stripped bare of leaves, looking brown and dead.

The grasshoppers, mostly *differentialis*, with a considerable number of *bivittatus*, when rising in front of me as I walked through the field, formed a cloud eight or ten feet high and so dense as to hide objects beyond them. Here I noticed a number of grasshoppers dead from the attacks of parasitic *Tachina*.

From this field I went to another, owned by the same man, which was also well filled with grasshoppers, but the injury here was less, especially around the buildings, where a large number of turkeys were doing excellent service in killing the hoppers and at the same time adding rapidly to their own weight.

In a field of sorghum directly adjoining there was also considerable injury, but *differentialis* seemed scarce, while a bright green species, *Acridium frontalis*, Thos., was abundant and apparently the principal agent of destruction. This species was also noticed here and in other places occurring in great abundance on the wild sunflower so common on these plains, and the question arose whether this was not its natural food plant and its attacks on sorghum incidental.

The day following I spent the forenoon with Dr. Sabin, who kindly furnished a horse and cart and accompanied me in examining a number of farms within five miles of Garden City, where alfalfa fields and orchards were injured. I met and talked with a number of farmers who had suffered from grasshopper depredations, and the information received from them with what I gained by personal observation satisfied me that losses could be avoided by proper measures.

I learned that the same injuries extended farther west along the river where alfalfa was grown, and I proceeded from Garden City to Lakin, observing on the way that all alfalfa fields showed presence of grasshoppers, but that in some cases the bloom was still free from serious injury or destroyed only in patches. At Lakin I learned that injury had been serious, especially on the place of Mr. Longstreth, some two miles from town. Some fields near the river and occupying low land were noticed in full bloom and showing little damage, but still grasshoppers could be found in abundance by closer inspection of the fields.

Mr. Longstreth's son, being in town, drove me out to his father's farm, and accompanied me on a tour through his extensive orchard of ten acres, his oat fields and alfalfa fields, in all of which the damage had been serious. Many of the trees in the orchard were entirely stripped of leaves, and in some cases the bark had been eaten from the limbs. The alfalfa presented the same appearance as observed in other fields. I found here a great many dead grasshoppers, whose empty shells attested the activity of *Tachinœ.*

I was told by Mr. Longstreth that skunks were amongst the most active enemies of the grasshoppers, and he believed played an important part in reducing them. He had even seen one up in an apple tree catching hoppers on the limbs.

I learned at Lakin that alfalfa was also grown in the next county west, at Syracuse, and that damage was also reported there, but on reaching the place found the injury slight as compared with the other places visited. In fact, aside from one farm on which some damage to alfalfa and orchard had occurred I could learn of no loss. *Caloptenus differentialis* I found in some numbers, and there is little doubt that unless some effort is made this fall and next spring to destroy eggs and young they will multiply as in other localities, and probably by next season prove as destructive as in them.

As this point carried me into the westermost row of counties in the State, and there was no report of damage farther on, I determined to cross northward to the Missouri Pacific Road, in order to follow up some rumours regarding damage from grasshoppers at some points intervening, and which, from the descriptions given, seemed possibly to be due to *Dissosteira longipennis.* No point where serious loss occurred was found, however, and this species occurred but sparingly at points between Syracuse and Tribune, and occurred at Horace only in small numbers, too few to cause any apprehension for the immediate future at least. Taking the Missouri Pacific, I passed through to Kansas City without finding any evidence of damage from grasshoppers, and as I could learn of no other localities in the State than in the three counties examined where such damage was reported, I returned to Ames, and will now proceed to a detailed account of the territory examined, the species observed, and the special measures needed to meet the outbreak in this section.

THE TERRITORY AFFECTED.

The damaged territory is quite easily defined and might very properly be said to coincide with the irrigated portion of the Arkansas Valley lying in Finney, Kearney, and Hamilton Counties in southwest Kansas. The entire irrigated district, however, is not equally injured and there are some fields much less damaged than others. The whole area covered extends with occasional breaks a distance of about fifty miles along the river and forms a strip from one to five miles wide but limited entirely to areas where irrigation has been practised, and within this limit is dependent upon the kind of crops raised.

The greater damage was observed at Garden City, though nearly as bad was seen at Lakin, and but little was found at Syracuse, corresponding as near as I could learn pretty closely with the length of time since alfalfa has been made a principal crop on the irrigated lands.

THE CROPS AFFECTTD.

Alfalfa is the crop in which there is the most loss, but orchards are suffering badly and were they extensive throughout the district would very probably present the heavier loss.

The alfalfa crop is a very profitable one aud easily grown with irrigation and has been very extensively planted, the fields devoted to it covering many thousands of acres.

The injury to this crop is of such a nature that I believe practical remedies may be adopted, and. as will be stated later, active measures should be adopted this fall and next spring.

THE AMOUNT OF INJURY.

The great loss this year has resulted from the destruction of the seed crop. In many fields this has has been a total failure, and the loss may be considered as covering thousands of acres and involving many thousands of dollars. One man who had something over 100 acres in alfalfa considered that his loss amounted to about $2,000. While he expected to cut and use the crop for hay, the damage had been such that the hay would be little better than after the seed crop had been secured, and he reckoned the full loss of the seed crop for the season. In some cases farmers were cutting for hay when they had intended to allow the crop to go to seed, and in this way were reducing the amount of their loss by the value of the crop of hay cut early over what the hay would be worth after maturing seed, the latter, of course, being much less valuable than the hay cut before seed matures. In many cases the farmers had been depending largely upon the crop of seed to help them out of debt, and the loss from the grasshopper injury falls heavily upon them.

THE SPECIES DOING THE DAMAGE.

The Differential Locust is, I think, chargeable with fully nine-tenths of the destruction, both in alfalfa and orchards, and the reasons for its increase in this section seem to be quite evident. The irrigated fields of alfalfa furnish it with favourite food in abundance throughout the year, and have given it an opportunity to multiply rapidly without exhausting its food supply.

The ditches which traverse the fields and possibly parts of the fields themselves furnish a most excellent location for the deposition of eggs, the ground being compact and for the most part undisturbed throughout the year. That the eggs are deposited in or alongside the ditches is indicated by several facts, though at the time of my visit the locusts, while pairing, were none of them ovipositing. In the first place, the greatest damage had occurred in strips on either side of the ditches, and only in the worst fields extends over the entire field ; second, at the time of my visit the pairing individuals were quite evidently collecting more particularly in these locations ; third, the testimony of those who seemed to have observed most closely agreed in placing the greatest number of young hoppers in spring along the borders of the ditches, a point which is clearly supported by the injured strips so plainly to be seen. No one whom I questioned had seen the locusts in the act of ovipositing.

The ditches contain no water during a large part of the year, and in fall the compact bottom, which doubtless affords more moisture than the fields in general, would seem an excellent place for the deposition of eggs, as well as the banks on either side. Judging by the habits of these and allied species in other locations it would be hard to conceive a more favorable place for the deposition of eggs, and it seems to me very probable that this, as well as the suitability and abundance of the food, may be considered an important factor in the rapid increase of the species in the last three or four years, an increase that has taken place directly with the cultivation of alfalfa by irrigation.

It would seem also that this habit renders the insect especially open to attack, and I see no reason why concentrated effort may not entirely prevent a repetition of the damage another year.

MEASURES RECOMMENDED.

The situation, it seems to me, is one deserving serious attention, but one which offers every hope for successful work, if the residents of the affected localities can but be induced to make a little effort at the proper time.

The injury for the present season is mainly past, as the grasshoppers are in large part mature, many already pairing, and the loss of the seed crop, the heaviest part of the loss, beyond repair. The effort, therefore, must be toward preventing the damage another year, and it seems to be very desirable that the Division should distribute to the people of this section a careful set of directions for their guidance this fall and next spring in working against the grasshoppers.

The means which appear to me from the inspection of the ground to promise most successful results would be as follows :

(1) To thoroughly break up the surface of the ground in and along the ditches before winter by harrowing thoroughly, cultivating or shallow plowing, thus exposing the eggs to winter weather and natural enemies.

(2) Wherever practicable, to flood the ground for a day or two at the time young locusts are hatching. I was told that the young hoppers were entirely unaffected by water, as they would crawl up the alfalfa stems and escape, and it is probable that sufficient flooding to accomplish much good in this region is out of the question. My only hope in this line would be in watching carefully for the time of hatching, and using the water before the hoppers had obtained any growth, and if abundant along the ditches, putting a little kerosene on the water.

(3) A use of the hopperdozer as early in the season as possible, when I believe the treatment of a strip eight or ten feet wide on each side of the ditches would destroy so large a part of their number as to prevent any serious damage. As I learned from a number of parties the hoppers are scarcely half grown when the first crop is cut, it would seem that immediately after cutting the first crop would be the best time to use the hopperdozer. The hoppers would be large enough to jump readily and the dozers could be run very easily. It would be difficult to use them at any other time then directly after a crop was cut, as the dense growth of alfalfa would obstruct their movement.

My strongest recommendation would be the urging of effort in breaking up egg masses before winter, and then in case locusts still appear in any number in spring to resort to the dozers at first opportunity. I believe active use of these measures will be effectual, with a cost but trifling compared with the value of the crop to be saved.

The information as to the species and the measures needed are covered very fully in your Bulletin on Destructive Locusts, and with some specific instruction regarding the treatment of ditches in this special locality would, I think, give the people of the district affected all the information necessary to protect themselves, and it would seem advisable to send a number of copies of that bulletin to the postmasters at Garden City, Lakin and Syracuse, to distribute to farmers who would make use of them, as well as to those whose names I will furnish for this purpose.

OTHER SPECIES OBSERVED.

The species next to *differentialis* that I should call most abundant in the injured fields was *bivittatus*, but taken alone its damage would have been insignificant. Its habits are so nearly like those of *differentialis* that I see no occasion to give it further mention, and I have little doubt that any measures adopted against *differentialis* will prove as effective against this species.

Still other species occurred, but seemed generally distributed, and so far as injury in the devastated fields is coucerned need no mention.

THE LONG-WINGED LOCUST.

Dissosteira longipennis was taken in some numbers at all points visited in Finney, Kearney, Hamilton and Greeley Counties, and as this species has caused so much injury in eastern Colorado this season, I took rather special pains to note its abundance and inquire as to any destruction resulting from it. At no point did it occur in destructive numbers, and I should not look for any injury from it in these localities in the near future at least.

Most of those noticed were winged, some still fresh from the pupa stage. In general all the winged ones, when disturbed, moved southward, but nothing like a general migration was seen. At Lakin I was told by a Mr. Logan that a large black-winged grasshopper had been common near that place, and when winged had travelled uniformly southward.

PARASITES AND DISEASE.

The many parasitized grasshoppers noted indicated a multiplication of such forms, and these will undoubtedly accomplish much in reducing the numbers that can deposit eggs this fall, but I should deem it unwise to depend on them and to omit the active measures already urged.

The most general parasite was apparently the Tachina flies, as the great majority of dead hoppers were found to be completely devoured within, and in most cases the opening through which the maggot had issued was to be seen. Adult *Tachinæ* were also observed in the infested fields.

Some of the dead grasshoppers had the appearance of having been affected with *Entomophthora*, and I gathered a number in order to make an effort to cultivate the disease, but as yet have nothing to report in this line. The dead hoppers will be kept with living ones, and if the latter take the disease we may hope to still further multiply the disease by inoculating still others, and then an effort can be made to distribute the disease in the fields. Its spread, however, is evidently slow, and I do not think other measures should be neglected this season for a plan which is still uncertain.

Among the natural enemies observed, toads were perhaps the most common, some of the fields containing great numbers of them, especially of half-grown individuals, and these would seem capable of greatly reducing the numbers of hoppers. A dead one, which saved me the necessity of making a dissection to get positive proof, showed in the partly decomposed stomach the legs and other parts of grasshoppers, proving that, as would be inferred from the presence of toads in the fields, their mission was to feed upon the grasshoppers.

The attacks of skunks upon grasshoppers, as stated by Mr. Longstreth, have already been mentioned.

As the tendency is for natural enemies to multiply with the increase of any species of insect, we may look for increased assistance from this source by another year, and in connection with the measures already urged, these ought by another year to keep the insect entirely within the limits of destructiveness.

THE CLOVER-SEED CATERPILLAR.

(*Grapholitha interstinctana*, Clem.)

BY H. OSBORN AND H. A. GOSSARD, AMES, IOWA.

On the evening of the 23rd of May many small dark brown moths were noticed flying about a clover field upon the College Farm. They were resting upon the blossoms and among the leaves, and upon being disturbed would fly a few paces and then settle again. These moths proved upon examination to be *Grapholitha interstinctana*, Clemens, the parent forms of the clover-seed caterpillar mentioned in the Entomologist's Report to the Commissioner of Agriculture in 1880. We had during the past winter received specimens of clover-seed which we suspected of being damaged by this pest, which has been reported as injurious in some of the states east of us in the last year or two. The moths are also remembered as occurring at Ames in numbers some eight or ten years ago. They were not, however, at that time connected with any damage observed in clover fields.

The moths increased in number from the time they were first observed until, by the 3rd of June, in the early evening, when the field lay between the observer and the sun, a perfect cloud of them could be seen hovering over the blossoms as far as the eye could reach. They would spring up from under the foot like grasshoppers in a meadow on a sunshiny day. It was also noticed that they were pairing freely at this time.

On the 24th of June an examination of 177 heads of clover taken from the field before mentioned showed 91 heads infested with the caterpillar of the moth as against 86 not infested. Many of the larvæ were full grown and some were spinning their cocoons. The hay was cut at this date. An examination the next day, June 25, of 48 clover heads taken from scattered bunches on the college campus, showed 8, or 16⅔ per cent., of the whole infested. Examining 42 heads from a different field, cut on the 23rd and 24th of June, only 3, or 7 per cent., were found infested.

The damage was done by eating into the young florets, and later into the seed vessels, causing the heads to dry up and the flowers to shell from the receptacles like chaff.

The larva is a small, greenish white caterpillar, with a dark brown head, about .25 to .30 of an inch long when full grown, many of them becoming tinged with red toward the hinder extremity as they approach the time of pupation. About the 24th of June the adults had nearly all disappeared, a few stragglers only being found by diligent search. Of a number of larvæ preserved in a breeding cage the first pupa was found July 14, but a visit the same day to the field before mentioned proved the second brood of the adults to have already appeared. An examination of dried bunches of hay left on the field disclosed some larvæ in the heads, which had spun their cocoons to pupate, from which it is concluded that the caterpillars can live in the cut hay for a considerable time if not hampered in their movements. An examination of the hay from the same field stored in the barn showed all the larvæ to be dead. A dead pupa was also found, but nothing living. There were no empty pupa cases found to indicate that any moths had escaped from the hay thus stored. It seems certain, therefore, that everything that was subjected to the pressure and heat incident to storage was killed. The remedy, then, for this pest, which has caused the destruction of probably 50 per cent. of the clover seed in the field observed, is to cut the hay soon after the first brood of larvæ appears, or in early June. The hay should be carefully cleaned from the field, so that no larvæ will find harbour in stray bunches which have not been gathered up. Scattered clover growing by the roadsides and in the fence corners should also be carefully mown at this time, and the heads at least disposed of in some manner to insure the destruction of the larvæ they may contain. This method can not but prove effective in reducing the second brood of the moths, and will also operate against the clover-seed midge *Cecidomyia leguminicola*.

The track of the larva is very uniformly from the base of the head upward, and the younger larvæ are almost invariably found near the base, and beginning their work on the florets there. It would seem, therefore, that the eggs are deposited at the base of the receptacle, and the larvæ upon hatching may begin at once upon the older florets. In working upward, roughly speaking, they usually form an irregular spiral track around the receptacle.

The delicate, white, silken cocoons of this insect are spun in the head among the dried florets, frass and bits of eroded but undevoured flowers so covering them with brown as to make them difficult of detection. The pupæ work their way entirely out of their cocoons and drop to the ground before bursting their pupa cases, which may be found in abundance on the ground from which a brood has just issued.

The second brood was observed pairing during the last week of July, and August 5 the larvæ were found in great numbers, one having at that time spun its cocoon preparatory to pupating. The rate of growth would seem to establish that there are three broods per year at Ames, and possibly, though not probably, four. [In advance from a forthcoming bulletin, No. 14, of the Iowa Experiment Station.]

STANDARD FITTINGS FOR SPRAY MACHINERY.

BY WILLIAM B. ALWOOD, BLACKSBURGH, VA.

(Abstract by Author.)

It is my desire to briefly present to this Association a matter with which doubtless many of your members are already familiar, and which I feel confident will meet the hearty approval of all the economic workers. At the Champaign meeting of the Association of Agricultural Colleges and Experiment Stations, held in November, 1890, I presented a paper before the botanical section, dealing with some of the newer forms of machinery used in fungicidal work, and pointed out the great inconveniences under which we labored from the diversity of styles and sizes of fittings and thread connections used in the various machines now offered by manufacturers. The subject was considered of such importance that a motion was carried to ask the sections of entomology and horticulture to unite with the botanists in appointing a conjoint committee, which should be charged with recommending to manufacturers such styles and sizes of connections and fittings as were thought to be most convenient in the practical work of treating injurious insects and the fungus diseases of plants. This committee, as finally organized, was composed of the writer, as chairman, Mr. G. D. Fairchild, assistant mycologist of the Department of Agriculture, and Prof. James Troop, horticulturist of the Indiana Experiment Station.

This committee issued a circular letter to manufacturers which met with a very general and cordial response from them. Nearly every one fully endorsed the ideas set forth by the committee, and most of the prominent parties agreed to carry out the committee's suggestions so far as practicable with the state of their business. By the time standard styles of fittings could be circulated among the makers of spray machinery the season of '91 was so far advanced that we could not hope to effect much change during the current year. However, now that interest and sympathy with this effort have been awakened, we believe that it is possible through united effort to secure all we ask in this line. While we are all aware that the members of this Association are in a large part station entomologists, it is also true that some very prominent members are not connected with station work ; hence my reasons for bringing this subject before you for discussion. To any one who has had actual experience in field work the importance of better, and, I will say, uniformly standard sizes of fittings, can not be doubted, and to aid in securing this desideratum is the chief purpose of my paper.

I shall at an early date publish an illustrated circular dealing with the question of styles and sizes of fittings, which will give detailed information, both for the use of manufacturers and the special workers.

On motion of Mr. Smith, seconded by Mr. Lintner, it was—

Resolved, That the Association of Economic Entomologists heartily indorses the work of the committee from the Association of Agricultural Colleges and Experiment Stations, appointed for the purpose of consulting the manufacturers of spray machinery, with the end in view of securing the adoption of standard sizes of connections and attachments on such machinery.

Further, the Association of Economic Entomologists urges upon the manufacturers of this machinery the importance of acceding to the request of this committee. The Association requests the committee to publish its recommendations, with drawings and descriptions for the information of manufacturers and special workers, and to include in this publication a list of all manufacturers who have agreed to conform to the standard sizes.

Mr. Kellicott stated that in his opinion firms which will not comply with the request to manufacture standard fittings should be requested to furnish an adapter to their machines which will enable their use with the standard fittings.

ENTOMOLOGICAL WORK IN CENTRAL PARK.

BY E. B. SOUTHWICK, NEW YORK, N.Y.

[Author's abstract.]

The work of the entomologists of the department of public parks is in the care of trees, shrubs and plants, under the directions issued by the president of the board of commissioners.

The work of removing the egg masses of *Orgyia leucostigma* was the first done in this department, when twelve men were employed to clean the trees, benches, walls, and stonework in the parks. The first autumn of our work we collected thirteen bushels of these cocoons and egg masses, leaving those cocoons that were apparently parasitized until the final cleaning. The large elms on the Mall were thoroughly cleaned with steel brushes made for the work, and each tree received a wash to destroy any insects that might be in the crevices of the bark. This work of collecting (and burning in the furnace) has been carried on each year as the force would allow, in this way keeping them in subjection. We now treat them in four different ways:

(1st) By hand-picking, of which bushels are each year taken from the trees with tools especially adapted for this work.

(2nd) By jarring the larvæ down with a pole, so arranged that a blow from a mallet on a projection placed at the large end of the pole will jar any down that may be on the branches. With a sudden blow most of them will fall to the ground, where they can be crushed.

(3rd) By poisoning the foliage with London purple, which is quite effective and used especially on very large trees that can not be treated otherwise.

(4th) By poisoning or spraying the trunks of large trees with an emulsion of petroleum and carbolic acid. This penetrates most of the cocoons sufficiently to kill the inmates, the disadvantage being that it kills the parasites too. This method is only resorted to when the egg masses are very numerous and we are short of help, and as a means of reducing the next brood. Large numbers of trees were so treated this season to arrest the late summer hatchings.

The next insect in abundance and destructive working was the Bag Worm, *Thyridopteryx ephemeræformis*. Whole portions of the parks were literally stripped of their foliage; many of the trees on the drives were nearly as bare as in winter. So abundant were they that the branches were strung with their cases, and with one push of the instrument prepared for collecting them, a handful of these cases would be taken. Four kinds of tools were made for this work, and the cases were collected and destroyed. In this way nearly twenty-two bushels have been collected and destroyed.

The *Datanas* have always been abundant in the parks, and as many as fifteen pounds of caterpillars have been taken from a single tree. These are collected while massed, as is their habit, and then destroyed.

Hyphantria cunea is very abundant in our parks and has been destroyed by cutting down the webs as far as was possible. If the tree was too valuable, they have been twisted out with poles made especially for this work. In some cases spraying has been resorted to, but as this does not remove the unsightly web, the most practical thing to do is to remove the whole colony.

Clisiocampa americana has this year appeared in our parks for the first time, and in great abundance. The webs that appear on the trees before they are in full leaf can be easily removed, and in this way the finer trees can be protected. The eggs are also removed in the late autumn and winter, as they are very conspicuous.

Vanessa and *Grapta* sp. are sometimes very abundant, and are collected and destroyed as soon as discovered. *Cecropia* and *Eacles* are always abundant and on many of the smaller trees do much damage. These are hand-picked and destroyed.

Alypia octomaculata (Fig. 17) is one of our most troublesome caterpillars, the great abundance of *Ampelopsis* vines in the parks, and especially around it, covering "squatter sovereignty" houses, affords congenial food for its rapid propagation. In the parks the vines are twice annually treated with a solution of London purple, applied with a spraying machine. This is found most effective and the vines do not seem to be injured as easily as most plants by the arsenites.

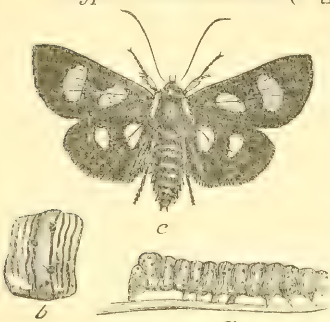

Fig. 17.

The Elm Beetle, *Galeruca xanthomelæna*, has given us an immense amount of trouble, and many thousand trees have been sprayed each year for their destruction, and with good effect. The means we have adopted during the past three years is rather more in the preventive line. As soon as the first eggs are found that part of the tree is at once sprayed. I am inclined to think the Elm Beetle is double-brooded with us.

The Elm Borer, *Zeuzera pyrina*, is getting to be very destructive with us, already twelve species of trees and shrubs are affected by it, and during the past year two men were kept during May at collecting the larvæ from broken branches. All branches as soon as detected in a weak or broken state are removed and the larvæ extracted. In very choice trees the limbs are carefully examined and where holes can be found bisulphuret of carbon is put in with an oil can and putty put over the hole. This is only resorted to in the case of rare trees and shrubs.

For scale insects the trees are washed with preparations and then cleaned with steel brushes, leaving all in fine condition. Many thousand trees and shrubs have in this way been put in fair condition.

A large number of poisons have been experimented with for *Aphis* and other insects, due notice of which will be given in reports soon to be published.

The spraying machine used by the department of public parks is a two-barrel machine manufactured by the Nixon Nozzle Company, Nixon, Illinois. This machine, to better adapt it for city work, has been entirely remodelled. A set of strong cab-wheels, with a strong axle, was first made, then a pair of strong easy springs, so as to make the tank less liable to jars. The tank was lined with zinc entire, and on top of the tank was placed a well about a foot high to keep the liquid from flushing over. On the rear of the tank was placed a box for poisons, hose, etc., and on the front a box for coats, lunches, and collecting cases and bottles. On one side of the machine and running nearly to the horse's breast was placed the bamboo pole used to elevate the hose and on the other side long handled pruning shears. Thus equipped the men drive all over the city and are at any time or place ready for work at short notice.

Our parks comprehend nearly 4,000 acres, and are from one extreme to the other sixteen miles apart. The work with the present force and appliances is chiefly centred in the island parks and places.

SOME HISTORIC NOTES.

BY A. J. COOK, AGRICULTURAL COLLEGE, MICHIGAN.

Upon special request, I am very pleased to state the following facts regarding the early use of the kerosene emulsion and of the arsenites.

I used kerosene and soap mixture, as I then called it, successfully in 1877. I used very nearly the same proportions that I prefer now, heated it to dissolve the soap, and I

think made a permanent mixture. Dr. C. V. Riley argues that I only made a temporary mixture, which he says was made years before, although I have been unable to find the record. Whether it were an emulsion or not, it was very successfully used, as successfully as in later years. That I appreciated the importance of the *emulsion*, or even recognized it or produced it except as an accident, is not true. Messrs. Barnard, Hubbard, and Riley did this as the result of extended experimentation, and heralded the facts forth to the world, and I gladly accord to them the chief credit.

As to Paris green, I believe my friend Hon. J. S. Woodward, of Lockport, N.Y., was the first to announce it as a specific against the Codling Moth, which he did in the autumn of 1878. He relates to me that he advised a neighbour to use it to destroy the canker worms. The neighbour observed that the trees treated were very free from Codling Moth larvæ, and Mr. Woodward divined the cause. I had a very similar experience the same year. Mr. J. W. Tafft, of Plymouth, Mich., came to me in 1878 with specimens of canker worms, which he said were destroying his orchard. I advised Paris green, which he used with the same results that greeted Mr. Woodward's neighbour. Mr. David Allen reported the facts to me. I said, "Can it be possible that the poison has worked this double benefit? I will test the matter." Mr. Woodward had already announced his belief in the matter. In 1879 I made the first careful test and proved by a most crucial test that Paris green was not only a specific against the insect but safe to use. The results of these experiments were given at the Boston meeting of the American Association for the Advancement of Science, August, 1879. The results which I then secured were remarkable beyond what may usually be expected or hoped for. This was because I treated a small tree and took special pains that every fruit should receive the poison. As great care to-day will meet with the same success. Thus while Mr. Woodward was the first to suggest and announce this remedy, I was the first to prove and announce positively that it is both safe and effective. So far as I know I was also the first to determine the best proportion—1 pound to 200 gallons of water—and to show that it is safe to pasture in an orchard at once after the poison is applied if the application is properly made.

AN EXPERIMENT WITH KEROSENE EMULSIONS.

BY HERBERT OSBORN, AMES, IOWA.

The most satisfactory method of preparing the valuable kerosene emulsion is desired by all, and a comparative test made this season may be of interest.

The first was a preparation in which the formula advocated by Professor Cook was carefully followed, using the hard soap and not the soft soap formula, the materials while still hot being thoroughly mixed with an egg beater.

The result was that we had what appeared to be an excellent emulsion, but in a glass jar we could soon see a separation taking place, the white emulsified part rising to the top and the water or soapsuds gradually increasing at the bottom. This continued until there was about two-thirds or a little more of soapsuds and one-third or less of emulsion above it.

While this at first could be readily mixed again a day later, the soapsuds in the bottom had hardened into a jelly that when mixed with additional water would but imcompletely dissolve and the clots included caused great inconvenience by clogging the nozzle.

The other preparation, made according to the usual formula for soap emulsion (the Riley-Hubbard formula), emulsified and remained fixed with but a very few drops of soapsuds gathering at the bottom, even after days of standing, showing that the proportions were such that the soap water and kerosene balanced each other. This thickened to a buttery consistence, but dissolved perfectly in water, and only a trace of oil arose to the surface when thus mixed.

A microscopical examination of the substance prepared by Professor Cook's formula showed the buttery mass above to be apparently a good emulsion, and the jelly-like mass below to contain scarcely any traces of oil globules. A similar examination of the second preparation showed in different samples as usual a uniform emulsion.

I conclude that in the first case I formed an emulsion, that is, the oil was broken into minute globules and these coated with a film of soapsuds so that they did not coalesce, but that there were such an excess of soapsuds that the emulsion separated therefrom and rose to the top.

It is evident, I think, at sight that the preferable preparation is the one which combines the proportions so that no excess of either ingredient results, for, as indicated, the hardening of the thick soapsuds results in clots and these interfere with spraying, while to skim off the emulsion and leave the mass below is a useless labor and loss of material.

In the Riley-Hubbard formula we have evidently the exact proportions carefully determined, and I feel obliged to recommend this formula when giving advice to those wishing instructions as to preparation of kerosene emulsion.

A NOTE ON SILK CULTURE.

BY PAUL WALLACE, LOS ANGELES, CAL.

[Secretary's Abstract.]

The author reviewed the attempts which have been made to raise Silkworms in this country, and stated that they had proven the entire adaptability of the United States to this industry. He stated that all that was needed to make it a success was either a bounty paid by the Government or an import duty upon raw silk, but to his own personal knowledge attempts in this direction were thwarted by the work of large silk manufacturers who were bitterly opposed to the establishment of silk culture in America. He urged that the Association should use its best efforts to foster a popular sentiment antagonistic to such efforts on the part of the manufacturers of silk.

Mr. Lintner, in discussing this paper, contended that there is no question as to our ability to raise good silk, but that it will not pay. He spoke particularly of the work of the division of entomology in experimenting in this direction.

NOTES ON A FEW BORERS.

BY G. C. DAVIS, AGRICULTURAL COLLEGE, MICHIGAN.

If we go on the principle that "every little helps," even though it be slight and incomplete, then perhaps a few notes incidentally picked up on our forest borers may be of some utility at this time. Dr. Packard's work on forest insects, so recently is-ued, is of inestimable value to the working entomologist, but by the reporting of the few observations we happen to make while at our other work we can make the volume still more complete and helpful. Perhaps the habits of some of these species may already be known, but as they have not been specially reported in this work, reference is here made to them.

From the maple was reared the Cerambycid borer *Acanthoderes decipiens.* It was found as a pupa in the rude chip case just under the bark. The cylindrical burrow made in its exit extended well in toward the heart of the tree and through quite sound wood.

Another Cerambycid, *Leptura proxima*, was found quite numerous in blocks of hard maple sawed from the tree the winter previous. The grubs were quite large, and it was

thought that they would pass through the transformations that season, but it was not until a year from the following May that the first beetle issued. From the data given it seems that the borer must require two or more years to reach maturity.

In "Forest Insects" Dr. Packard mentions *Lyctus striatus* under the list headed "Found in rotten oak wood; not known to be injurious." We have quite recently found them issuing from a red oak floor in one of our college halls. The floor was laid two years previous to the time of this appearance, and the lumber was seasoned at that time. The beetles issued from the sap wood only, and probably were feeding there when the tree was sawed into lumber.

In order to learn more of their habits quite a number were placed in a glass jar containing a branch of green oak, one of dead oak, and a seasoned stick from the shop. The beetles preferred the latter when first introduced, and made themselves at home by boring a hole entirely through it diagonally the first night. Mating took place in a few hours after issuing and eight days later ovipositing was first noticed. Mating again took place before each egg was deposited. This seems essential, as a female was placed by herself immediately after mating the first time, and, although watched for several weeks after the others had died, no sign of ovipositing was noticed. The branch of green oak was preferred in depositing the eggs, and none were placed on the stick from the shop. Ovipositing occurred about once in half an hour and lasted but one day. One week after oviposition young larvæ were found. We are in hopes to get the complete life history from them.

From the oak posts of one of our summer houses were taken quite a number of *Phymatodes dimidiatus* along with *P. varius.* Four different kinds of wood—elm, maple, hickory, and ironwood—besides the oak, enter into the construction of the chalet, but none of the others showed signs of borers, while the oak was well perforated. The species seem to work mostly just beneath the bark.

Two specimens of *Alaus oculatus* were taken in the trunk of a white oak near the partially decayed heart. A full-grown larva of this was also found in the trunk of a "sappy" aspen.

On the 10th of June a piece of bark was torn from an aspen (*Populus tremuloides*) that had but recently died, and under it signs of insect depredations were quite evident. Upon further investigation the bark and wood were found to be almost entirely separated. Underneath, the wood was yet sound and quite green. Here were found galleries penetrating almost to the heart, and in them were found *Enchodes sericea* in the imago stage, although some of them were yet in the pupa case and nearly as soft and white as a pupa.

These beetles belong to the family Melandryidæ, which contains a number of quite diversified genera that in general live on fungi or under bark. As far as their habits are known those living under bark do not seem to be injurious as borers, and whether we can consider this species as merely working in decayed wood or as a borer in green wood can hardly be decided by this one instance. It is certain that the larvæ are *capable* of penetrating sound wood.

The beautiful little Buprestid, *Pœcilonota cyanipes* was reared from the aspen. When found, June 9th, it was in the pupa state in the axil between the body of the tree and quite a large branch. So much had been eaten around the base that the branch was already dead. Mr. Harrington reports capturing the species on a dead willow stump, and Mr. Fletcher a specimen on a dead aspen stump in Ontario.

Galls made on branches of the willow, *Salix discolor* by *Agrilus torpidus* have been found quite common in certain districts near here, and in other districts was found *Saperda concolor* in galls equally as numerous. In no case yet noticed have the two been found in close proximity. The galls made by the Buprestid are an oval swelling of the live branch very similar to the one made by the Saperda. Inside there is a difference in the architecture of the home. While the Saperda remains mostly within the swelling and makes its exit through it, the Agrilus bores an oval gallery downward from the gall, sometimes in the pith, but oftener indiscriminately through the wood, and makes its exit often an inch and a half below. The imago issued about a month later than the Saperda.

From the Saperda galls were reared two specimens of parasites. One of these is *Pimpla pedalis* and the other belongs to the genus Bracon, which we have yet been unable to get named.

Galls on the willow also yielded us a few specimens of the handsome Sesiid, *Sciapteron tricincta*, as named by Professor Fernald. The galls did not differ in appearance externally from the others. Inside the gall a tunnel was made downward along the centre for an inch. The whole cavity was lined with a soft, delicate, though very strong, buff cocoon, and undisturbed in this silken bed the larva passed through its transformations to the moth.

From *Hylesinus acuelatus*, the Ash Scolytid, was reared a species of Bracon, pronounced by Mr. Ashmead as probably a new species.

From a species of trefoil, *Ptelea trifoliata*, was reared a species of the Tineid genus *Hyponomeuta*. Wherever the shrub was found the thin white web was quite common early in the spring before the leaves were out. These webs were always at the terminal portions of the green shoots. The caterpillars, entering the stalk usually at the terminal bud, would bore down through the pith some three to six inches in the shoots connected by the web. The larvæ seem to remain in the stalk only part of the time, but spend the remainder of the time above in the web. The twigs, of course, are killed down as far as the larvæ go, which greatly mars the symmetry and beauty of the bush. This habit of boring is probably a generic characteristic, as several European species are mentioned as having similar habits.

THE POPLAR GONIOCTENA.

BY A. J. COOK, AGRICULTURAL COLLEGE, MICHIGAN.

The past spring the poplars about the Michigan Agricultural College were seriously and extensively defoliated by a Chrysomelid beetle, *Gonioctena pallida* Linn. The larvæ were first found in early June, so that we did not have the eggs. The larva is much like the Elm-leaf Beetle in form and colour. The beetles appeared June 21. They are yellowish brown, except the eyes, epicranium, two horn-like spots, and a central oval spot on the posterior portion of the prothorax, the scutellum, two large spots, one on each elytron near the scutellum, two nearly as large rounded spots near the suture, and just posterior to the centre, three small spots along the lateral margins, and the entire underside of the body except a narrow margin, which are black.

The beetles came forth late in June, but we found no larvæ or eggs.

NOTES OF THE SEASON FROM SOUTH DAKOTA.

BY J. M. ALDRICH, BROOKINGS, S. DAKOTA.

Cutworms have been more injurious than ever before. From limited data, I judge that the loss in the State reaches several millions of dollars. Corn, flax, gardens, and other crops suffered about in the order mentioned.

At our station the large Willow Sawfly (*Cimbex americana*) is much less injurious than for several years. I have reared six or seven species of parasites from it, four of them being numerous.

The Cottonwood Leaf Beetle is with us in large numbers, as usual. Our experiments in spraying with arsenites for this insect are more successful than heretofore, and I now feel confident that it can be controlled (though not exterminated) by this method. Our new Russian poplars, so desirable in other respects, are chosen by the beetle in preference to cottonwood.

Gooseberries have suffered from a combined attack of the Spanworm (*Eufitchea ribearia*) and the Sawfly. I have not observed the latter in our State till this year.

The Ash Borer (*Trochilium fraxini*, Lugger) is still increasing rapidly, and will probably destroy most of the ash trees in the neighbourhood of the station in two or three seasons more. The Ash Sawfly and the Sphinxes (Ceratomias) are assisting to a noticeable extent. The ash is a bad investment in our locality.

In May the station procured five colonies of bees, aiming merely to see what they would do, with ordinary care, in a region devoid of natural timber with its accompanying honey plants (the nearest is five miles away). We have now increased to ten strong colonies. I have taken off 35 pounds of fine honey, and shall probably get 100 pounds or so of fall honey. Considering that the original swarms were weak, I think the record good so far. Of course the winter will try them.

A building 16 by 32 was erected this year for our department. It has a wing 12 feet square for bees. In the main part we have an office and a small breeding room. We moved into the new quarters July 1.

A NOTE ON REMEDIES FOR THE HORN FLY.

BY WM. B. ALWOOD, BLACKSBURG, VA.

This plague to cattle, which has now become so common throughout several of the Atlantic coast States demands attention from workers in economic entomology. Doubtless some very good recommendations have been made by Dr. Riley, Professor Smith, and others, but as conditions vary we are bound to treat such questions from the standpoint of local practicability. The recommendation to lime the droppings when practical may prove a very good way of dealing with this pest, but with me it is quite impractical from the fact that lime is neither cheap nor easy to procure, and this is the case in many parts of Virginia.

Some two years since, from a suggestion of mine in a lecture at Charlottesville, Va., the late Henry M. Magruder began the use of kerosene emulsion on his dairy cattle. The application was made with a Japy knapsack pump, and though it had to be repeated with frequency, proved a considerable success. During the year 1890 I frequently recommended this remedy, stating that the standard emulsion (Hubbard formula) should be diluted ten to fifteen times.

The Horn Fly did not become troublesome at our place, which is in the upper mountains of southwest portion of the State, until late in 1890, and I did not as a consequence, have opportunity to treat this insect myself. However, the present year they showed themselves in abundance in July, and I concluded to try my own recommendations.

The experiments were made upon ten dairy cows, beginning with plain emulsion diluted ten times. I found that this killed a majority of the flies actually wetted with it and produced considerable immunity from attack for the space of one or two days. Desiring to make the treatment more effective, I used as diluent a water extract of tobacco waste, made by thoroughly boiling one pound of tobacco in each gallon of water. This used with emulsion, 1 to 10 parts, gave almost perfect immunity for a period of three days.

My work shows that two treatments with this preparation per week almost entirely relieve the cattle from annoyance. I make the application with a knapsack pump fitted with a cyclone nozzle. The work is most conveniently done just after milking in the morning. Two men treat the cows rapidly, requiring about one minute per cow, and using from one to two pints of liquid. The preparation as given above causes no particularly unpleasant odor, and thus far the milkers have made no complaint whatever concerning its use on cows.

The President announced that he had received letters of regret from Mr. J. H. Comstock, Mr. C. W. Hargitt, Mr. H. Garman, Mr. C. P. Gillette, and Mr. C. H. Tyler Townsend.

On motion of Mr. Alwood, seconded by Mr. Smith, it was resolved that Mr. Riley be requested to publish the proceedings of this meeting in *Insect Life*, and on motion of Mr. Smith, seconded by Mr. Bruner, the Secretary was instructed to send an abstract of the proceedings to the *Canadian Entomologist.*

On motion of Mr. Southwick, the Association passed a vote of thanks to Mr. Riley and the members of his office force for the courtesies to members during the meeting of the Association.

On motion of Mr. Osborn, a vote of thanks was extended to the President for his able efforts to make the meeting a success.

The Association then adjourned.

L. O. HOWARD,
Secretary.

Just after the adjournment of the meeting the following communication was received from Mr. Snow, one of the vice-presidents of the Association, which, although it can not properly be incorporated in the minutes, may be properly appended here:

THE CHINCH BUG DISEASE AND OTHER NOTES.

BY F. H. SNOW, LAWRENCE, KANS.

In response to your circular letter asking for notes of work done in economic entomology during the past year I beg to submit the following brief and incomplete account of the work done in Kansas this year under my direction in the matter of the artificial dissemination of a contagious disease or diseases among chinch bugs:

The legislature of the State of Kansas at its last session in the winter of 1890-'91 made an appropriation of $3,500, available during the years 1891-'92, for the purpose of carrying on these experiments. With this money I have been enabled to largely increase the facilities of my laboratory and to conduct on a rather extended scale practical experiments in the field. According to a provision in the act of appropriation, I am required to make a monthly report to be printed in the official State paper of Kansas, the *Topeka Daily Capital.* From my last report, made on July 15, I quote as follows:

Since making the last report, June 15, the wheat has ripened and mostly been harvested. The chinch bugs at harvest time left the wheat fields and invaded the fields of young corn. The experiments of 1889 and 1890 were carried on among bugs in the corn fields, and the experiments of this year in wheat fields are thus new features in the work. The results have been gratifying, but the reports from this year's corn fields and the investigations of my field assistant, Mr. Hickey, show that the massing of the bugs in the hills of corn offers more favorable conditions for the successful workings of the disease than the usual conditions incident to the presence of bugs in wheat.

The hatching and appearance of the young bugs is a feature in the work added since the last report. It is with satisfaction that I note the evident communicability of the disease from old to young bugs by contact. The young bugs are as susceptible to the infection as the old ones.

The part of the State reporting bugs in the corn fields lies between 96° 30′ and 98° 30′ west longitude; or between a line drawn through Marshall, Pottawatomie, along the eastern boundary of Geary, Morris, Chase, and along the eastern boundary of Greenwood, Elk and Chautauqua Counties, and a line drawn along the eastern boundary of Jewell, Mitchell, Lincoln, Ellsworth, Rice, Reno, Kingman, and Harper Counties. This bug-in-

fested belt extends clear across the State from north to south. Scattering reports of the presence of the bugs are in from various eastern counties, and from a few west of the 98° 30′ line.

Up to date (11 a.m., July 15) infected bugs have been sent out from my laboratory to 1,700 applicants. To several of these applicants second lots of infected bugs have been sent, owing to failure to use the first lot for various reasons, and occasionally because of failure to get good results from the first experiment. But as many, if not more, persons have got dead bugs from fields wherein the bugs are dying because of infection sent out from my laboratory as have received bugs directly from me. Each successful field experiment has been the means of establishing a secondary distributing centre. It is evident that the experiment of killing chinch bugs by infection with fungoid and bacterial disease is being given a trial on a large scale. The reports for the past month (June 15 to July 15) have been gratifying, in that they show a good percentage of success. However, reports are not made out as carefully as they should be, and worse, many experimenters make no reports. I desire to have a report on every lot of infected bugs sent out.

Because of the difficulty of getting careful reports from the field, I sent out Mr. E. C. Hickey, an intelligent university student doing special work in natural history, as a field agent. Mr. Hickey's last trip was through Chautauqua, Harvey, Sumner, Cowley, Butler, Greenwood, and Elk Counties, lasting from June 12 to July 6. He visited seventy-two persons who had experimented with infected bugs, and found over 80 per cent. of the seventy-two experiments successful. Mr. Hickey personally visited the corn fields, and verified by careful observations the statements of the farmers.

The laboratory facilities for sending out infected bugs have been largely increased, and all demands can be promptly met. Application for infected bugs received in the morning's mail are answered with bugs and directions on the noon outgoing trains. The work of scientific investigation in the laboratory is going on steadily and carefully. Inoculation experiments from pure cultures of Sporotrichum will be reported on next month. A feature of the work unnoticed previously in this report is the prevalence of Empusa, the fungus with which the first successful experiments were conducted. Empusa and Sporotrichum develop side by side in the infecting cages, and dead bugs sent in from fields where the bugs are dying show both fungi. At the close of the season I hope to present a full report of the laboratory investigations, which the brief monthly reports offer no space for. Prof. S. A. Forbes, the eminent State entomologist of Illinois, who has experimented in his laboratory on the development of parasitic fungi in insects and who early noted the bacterial disease of the chinch bugs, visited my laboratory last week. He expressed the hope that a series of field experiments such as are now being carried on in Kansas could be conducted in Illinois.

In closing, I may say that the outcome of the work so far this year is highly encouraging.

Since making this report the requests for infected bugs have grown much less numerous. The laboratory experiments have been carried on with more attention paid to bacteria. So far I have been unable to successfully infect bugs in the laboratory from pure cultures of Sporotrichum. The Sporotrichum grows readily on a medium composed of beef broth and Irish moss, and pure cultures are easily obtained. Other experiments with these cultures are necessary, however, to make this statement positive. Empusa will not fruit on the plates. It behaves very peculiarly. Long erect filaments are sent out strikingly different from the customary hyphæ, but no spores are produced. As regards the bacteria, I am assured that the forms in my cultures are identical with Burrill's *Micrococcus insectorum*, two slides of which have been furnished me by Professor Forbes. This Micrococcus is found almost without exception in bugs which have died in the field and been sent in for examination. Another Micrococcus, larger and almost perfectly circular in optical plane, is often present in dead and dying bugs. Spraying experiments with fluids containing this Micrococcus give no successful results in infection.

I am not in position at present to make a full report of the season's work in the field and laboratory. This report I shall make late in the fall.

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Other injurious insects besides the chinch bug in Kansas especially noticeable this year were the Hessian Fly, in about the same abundance as usual. Much damage is annually done by this pest. The Wheat Straw Worm (*Isosoma tritici*) was reported from a dozen or more counties of the state in June. It occasioned considerable alarm and really did some damage to the wheat in central and western Kansas. I received reports of the presence of the worm from twenty-seven correspondents. It appeared in wheat which had been planted on stubble ground, though the state of affairs shown in one or two reports contradicted this general condition. One correspondent reports the worm in wheat planted on sod ; another in a field of 40 acres new ground, only grown to wheat once before, plowed last fall and after the wheat had come up fed off so close that the field looked quite bare. The Wheat Head Army Worm (*Leucania albilinea*) was reported in June from a few fields. However, little damage was done.

An attempted grasshopper scare was put down by a little investigation. Grasshoppers were reported to be in immense numbers in eastern Colorado and overflowing into Kansas. I made a trip to the infested region and found the grasshoppers to be a local species (*Dissosteira longipennis*) which was in great abundance over about 300 square miles of country near Arriba, Colo. Of course, no danger to Kansas was to be feared from these locusts. Arriba is 70 miles west of the Kansas line. The limits of the infested area extended approximately from Limon 16 miles east, 9 miles north, 7 miles west, and diagonally southeast to Hugo, 15 miles. Within this area the two favoured grasses of the range, buffalo and gramma grass, were eaten to the ground. The swarms when visited (July 17) were almost entirely composed of pupæ. Reports agree that the eggs from which these swarms were hatched were deposited last fall by the locusts which flew into this area in August and September from the south. And by observations during my trip and by regular reports received since then I discovered that the locusts as fast as their wings were acquired were flying south. Whenever there was a favouring wind from the north the winged individuals would rise high in the air and fly directly southward, having massed in great numbers along the southern boundary of the infested area. When the wind was from the south, however, no flying would be indulged in.

The rate of progress of the army of immature locusts was northward at the rate of 9 miles in about two weeks ; eastward at the rate of 2½ miles in 12 days. Over the face of the country traversed by the hosts the ground looked bare and brown, owing to the almost complete destruction of the grass leaves. When the devouring multitudes were at work upon the grass the noise of the grinding of their jaws was distinctly audible as a well-defined crackling sound. About the station of Limon the hogs of the town were fattening upon the locusts, which also furnished food for turkeys, chickens and hawks.

ENTOMOLOGICAL CLUB OF THE A. A. A. S.

The Entomological Club of the American Association for the Advancement of Science, held its annual meeting at Washington, D. C., August 19-22, 1891, the President, H. Osborn, of Ames, Iowa, in the chair. This meeting was one of the most successful ever held both in point of attendance and interest ; seven sessions were held, at which forty-two persons were present, the average attendance being twenty-two. The Entomological Society of Ontario was represented by its Vice-President, Mr. James Fletcher, of Ottawa. A full official account of the proceedings has been published in the October and November numbers of the *Canadian Entomologist* (1891) to which the reader is referred.

THE NORTHERN MOLE CRICKET. (*Gryllotalpa borealis*, Burm).

BY JAMES FLETCHER, OTTAWA.

The above-named and most interesting insect is I believe rare in Canada, as I have for some years endeavoured unsuccessfully to obtain Canadian specimens. Good luck, however, has at last favoured me. During the month of September last I was much pleased to find amongst several packets of "live-stock" sent in for identification, one containing a fine living female Mole Cricket. This was sent by Mr. W. W. Hilborn, who had caught it in his garden at Leamington, in Essex county, Ont. My correspondent stated that the insect was the first he had seen, and that none of his neighbours knew it.

Upon opening the box carefully an exceedingly active seal-brown velvety creature was seen to burrow down out of sight beneath the light earth with which the box was half filled. The contents of the box were then emptied into a tall glass jar, which I keep for the purpose of examining strange or refractory prisoners when they are first sent in. I at once recognized my visitor as the long looked for mole cricket, and my pleasure was much enhanced by finding it a far more beautiful and interesting creature than I had anticipated. The only way to understand the habits of insects properly is to study them in a living state, and the pleasure thus derived is so great that all who once begin this method of investigation soon become fascinated with it. The Mole Cricket seems to be easily domesticated, and I have now had this specimen in confinement for nearly three months in a glass jar in my office, and it is apparently in perfect health. From being nocturnal in its habits and passing nearly all its life beneath the surface of the earth, it is rather difficult to observe.

Its movements as it runs over the surface of the ground or over the hands are less insect-like than those of any member of that class which so far has come under my observation and remind one very forcibly of the movements of an otter. Its bright black eyes and the way it turns its head and looks up at you giving it a very animal-like appearance.

A few weeks after the arrival of the female another specimen was sent to me from the same locality, by Mr. George H. Mills, of Leamington. It had been found in a ditch which was being cut through a swamp, and it was stated that it had appeared to be perfectly at home in water, swimming with great ease. This proved to be a male but it had been injured in some way during its journey of 500 miles in the mail bag and died a few days after arrival. The Mole Cricket (Fig. 18) belongs to the order *Orthoptera*, which contains the grasshoppers, locusts, cockroaches, etc., and to the family *Gryllidæ* or crickets. It takes its name from its resemblance in burrowing habits to the small mammal after which it is called. For these habits it has its front pair of legs similarly modified so as to especially adapt them for digging. They are certainly the most remarkable feature about this insect and deserve special attention. They are short, but exceedingly strong. The tibiæ or shanks, which can be closed tightly into grooves on the thighs, are flattened and broadly triangular in shape, bearing on the lower edge four curved and hollowed claw-like projections, the outer two of which are distinctly articulated at the base. These digging "hands" are turned somewhat obliquely outwards like those of the mole, and this throws the tarsi or feet to the outside where they are attached to the shanks at about its centre. The feet are no less remarkable than the shanks; they consist of three joints, the first two of which are broad, flattened and claw-like, the first much larger than the second. These two joints lie obliquely in front of, and reach as far as the tips of the two articulated claws of the shanks, which undoubtedly strengthen them very much when in use. The third joint is small, oval in shape, and bears two weak, almost straight claws; this joint lies at the back of the first two and is almost hidden between them and the two corresponding claws of the shank. The other legs are comparatively weak and the hind legs are not formed nor strengthened as in other crickets for leaping, they are twice as long as those of the second pair; but are only slightly swollen.

Fig. 18.

The female which is larger than the male, is a little more than $1\frac{1}{2}$ inches in length from the front of the head to the end of the abdomen, and the antennæ and tail-bristles are each about half an inch more. The head is small, dark brown and moveable, the eyes oval, black and shining, and when the insect is alive the facets do not show by reason of their small size. Between these two compound eyes, but higher up, are two simple eyes or ocelli. Pro-thorax large and prominent and like the powerful fore legs which it bears is covered with a short velvety pile of a rich seal-brown with a golden reflection. The wing-cases are short, $\frac{3}{8}$ of an inch in length, pale gray, broadly veined with black, somewhat oval* in outline, with a deflexed outer margin, and lie flat on the back. The wings themselves are also small and lie folded up like a fan beneath the wing-cases, the tips exceeding them in length by about $\frac{1}{8}$ of an inch and reaching rather more than half way down the abdomen as two slender white bristles. The whole body is covered with a fine velvety down which is most conspicuous on the forelegs and the inner side of the shanks of the second pair of legs, there are also scattered over the body a few slender hairs $1\frac{1}{2}$ to 2 mm. in length, which are most abundant on the tail-bristles. The female does not chirp and has no ovipositor. She is distinguished from the male by having no notched nervure on the wing-covers and having the nervures more regularly arranged. The females, too, have only 7 segments to the abdomen while the males have 8.

The habits of this little creature are strictly nocturnal, and it is possible after all that it may not be so rare in Canada as is supposed. Prof. Comstock says "It is not a common insect, but occasionally it is found in great numbers in a limited locality. It inhabits nearly the whole United States east of the great plains, from Louisiana to Massachusetts."

It lives in light moist ground, near streams, burrowing beneath the surface and seldom coming out except at night time. Prof. J. A. Lintner says (Rep. VI. 1890, p. 150) "it burrows into moist earth to a depth of 6 or 8 inches by means of its front pair of legs, which are admirably constructed for digging. Its eggs are laid in these galleries in a tough sac, to the number of from two to three hundred, within a chamber scooped out for the purpose. Here it feeds on such roots of plants as may come in its way. Occasionally these crickets occur in large numbers, when they may become very injurious, destroying grass and garden vegetables, and in one instance they are said to have nearly ruined a crop of potatoes. Their chirp differs from that of other crickets in being a dull, interrupted, jarring sound, which has been compared to that of the goat-sucker. The song of the male during the warm nights of early summer has been described as 'a low, continued, rather pleasant trill, quite similar to that of the common toad but more shrill.' Mr. S. H. Scudder has written at some length on the chirp of the Mole cricket, in *Psyche*, for October, 1885, I. p. 105-6. He has written its notes and has described them as a guttural sound like *grü* or *grèèu* repeated in a trill indefinitely, but seldom for more than two or three minutes and often for a less time. It is pitched at two octaves above middle C."

The food of the Mole Cricket like that of the Field Cricket (*Gryllus*) seems to be both vegetable and animal. I have never, however, been able to see my specimen feed, and when worms or insects have been placed in its way it has shown fear, and either run quickly backwards or burrowed down out of sight, but Brehm in "Les Insectes" I. p, 448, gives the following of *G. vulgaris* the European species. "The autopsy of a large number of Gryllotalpæ revealed along the whole intestinal canal, legs and antennæ, heads of ants perfectly recognizable. I easily kept some in captivity for several weeks in jars filled with mellow earth, and fed them with meal worms and mud worms, upon which they rushed eagerly, when presented to them with forceps." The Rev. J. G. Wood in "Insects at Home," says they relish raw meat.

The habits of the European Mole Cricket appear to closely resemble those of our Canadian species, and the following kindly translated for me by Prof. J. A. Guignard from Dr. J. Ritzema Bos's valuable treatise "Animals Injurious and Beneficial to Agriculture" (Tierische Schadlinge und Nutzsing fur Ackerbau, etc.) will give a clue to some points not yet observed with regard to our Northern Mole Cricket. There is a difference in the nature of the egg receptacle as stated by Prof. Lintner and Dr. Ritzema Bos.

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* Less so than shown in the figure.

"Shape ungainly; feelers and testers (*palpi*) very long, as well as the tail-bristles. The forelegs are real digging legs and at first sight seem very much like the fore-paws of the mole. The thighs are broad aud flattened, the legs likewise short and flat; bear inward five (*sic*) saw teeth. The joints of the foot are small; the foot is implanted on the outer edge of the leg and can be folded backwards. The two leathery fore-wings cover each other almost completely and the posterior wings only in part. The latter are mostly folded in the shape of a fan and lie on the back in the shape of two little tails. The Gryllotalpa is of a dark brown color."

"This insect lives generally in swampy ground containing some sand or clay, and besides in all kinds of soil rendered cohesive by much manure. Its occurrence is also local. It hybernates in a torpid condition; it leaves its retreat very early in the year. Its burrows may be found as soon as March, extending at a small depth under the surface of the ground. At the spot where the female intends to build her nest, the burrow slopes a little downward; the walls of the nest are hardened by pressure with the hard back, so that the nest can be extracted in one mass from the ground. The diameter of the nest is about 4 cm; the entrance is narrow and somewhat crooked. The number of the eggs varies usually from 200 to 250. They are not laid all at once; after having laid a little heap of eggs, the female leaves the nest and comes repeatedly back to it. The eggs are about the size of a rape seed, but are egg-shaped and yellowish. All the eggs in one nest are also not of a uniform size. One month after being laid they hatch; the young are at first white, but soon become brown above and dirty yellow beneath. On their emergence they are already of a shape similar to their mother's. The latter watches faithfully over her brood, remaining with her young until the last egg is hatched; meanwhile the nest is enlarged in size to make room for the growing insects, while at the same time new food is laid bare in the roots successively uncovered."

The young grow rapidly, and after the first moulting remain still under the care of their mother; they may then go out of the nest, but never to any great distance. They can only after the second moult do without the mother's care and begin their independent life. The third moult follows in October or November, they then bury themselves, still without their wings, in their winter quarters.

The fourth moult takes place in April or May next, when the wing cases appear, and after the fifth moult, in May or June, the Gryllotalpa attains its full size and has become an adult winged insect. From what precedes it follows that it requires a whole year for its evolution.

The Gryllotalpa lives in orchards, gardens, meadows, even in nurseries and woods, and is everywhere equally destructive. Generally it prefers dry ground to wet ground, without altogether avoiding the latter. It gnaws the roots of various plants, and not a single plant can be named which it does not attack; it does not even spare the roots of fruit or forest trees, though preferring herbaceous plants to the harder roots of trees. Consequently when the Gryllotalpæ are very abundant they do considerable harm. Witewaall, a skillful Dutch farmer, writes as follows on the subject: "In a vegetable garden the damage by the Gryllotalpæ was constantly very great; the owner paid his men a penny for every captured specimen. One day, after very hot weather, it rained heavily, so that the garden was partly flooded. When the water had been absorbed by the ground the men went on to a plot where cabbages were severely damaged by Mole Crickets. The plot was dug up, and on a surface of two-fifths of an acre there were obtained 1,400 full grown Mole Crickets.

"This insect burrows close to the surface of the earth, and in so doing raises somewhat the surface after the same fashion as the Mole. Young plants are thus raised out of the ground, and older ones also die when the Mole Crickets burrow amongst their roots. In vegetable gardens whole rows of peas in a bed are often seen to die suddenly as a result of the operations of a single individual. Over the nest all plants wither. In short this insect must rank as one of the most injurious, and the opinions of those authors who consider Mole Crickets injurious only on account of their burrowing and not on account of the injury they do by gnawing the roots appear to be quite mistaken. In such localities as Mole Crickets occur abundantly the roots are gnawed off to such an extent that plants can be raised up by the leaves."

Besides the above a great deal of interesting matter concerning these insects is to be found in Westwood's " Modern Classification of Insects." It is there stated that " of all vegetable food they prefer potatoes; but if raw meat were offered them they attacked it in preference to anything else with great greediness. Gould also states that he fed a Mole Cricket for several months on ants."

Remedies.—There would seem to be no doubt that where these insects occur, as is sometimes the case, in large numbers that they cause serious injury to crops. The best remedy would probably be poisoning the adults either by dipping slices of potato or raw meat in some mixture containing arsenic, as White Arsenic, Paris green or London purple, and then placing these in or near their burrows. In Germany, where they are often abundant, says Dr. Bos, " The best remedy is the destruction of the nests, preferably in June. These are sought for in spots where the plants are dead and weakly. The nest must be carefully taken out whole when its presence has been ascertained by the finger.

Flower pots with their holes plugged may be used as traps by burying them in the ground so that their edge be on a level with the burrows.

The insects pair in the spring, and in early summer they may be entrapped in glazed pots partly filled with water and sunk up to their edges in the alleys between the beds.

Pouring water in the burrows has also been recommended, and the Mole Crickets are then killed when they have thus been driven out, but I doubt the efficiency of this method, as the insect has more than one entrance to its retreat.

Finally, horse manure may towards winter be thrown into ditches between the beds of vegetable or flower gardens. The Mole Crickets like warmth; they can thus be enticed into the manure and then killed."

The figure (18) used above has been kindly lent to me by Prof. J. A. Lintner, and is the same as was used to illustrate the article cited in his Sixth Report.

NOTES ON JAPANESE INSECTS.

BY W. HAGUE HARRINGTON, OTTAWA.

My absence from Canada during the past summer interrupted my studies of our own insects, and has prevented me from preparing any paper upon them. I venture, however, to offer a few observations of a general character upon the insect fauna noted in my somewhat extended travels in the Sunrise Kingdom; my object being briefly to indicate wherein the fauna of that country more closely resembles, or differs from, that of Canada. Leaving out the many small islands which stretch far to the north and south, we find that the four large ones (Yezo, Hondo, Shikoku, and Kiushiu) which constitute Japan extend from 31° north latitude to 45° north latitude, or in other words, from the latitude of New Orleans to that of Ottawa; the capital, Tokio, (and Yokohama) being in the latitude of Cape Hatteras. This extent of one thousand miles from north to south affords room for much variation of climate, which is further greatly influenced by the Kuroshiwo or Black Stream (the Gulf Stream of the Pacific), and by other currents flowing along the coasts and between the islands. The country is also intersected by many mountain ranges, and has many lofty peaks, some of which are active volcanoes. The naturalist may find in a few hours' climb upon one of these mountains almost as great a range of vegetation as if he travelled to the northern extremity of the empire. As an instance of such changes in the flora I may mention that in a trip from the railway station at Gomba to the summit of Fuji-san the first four miles of our road ran through fine cultivated fields with a light soil composed largely of fine ashes thrown out by the volcano in past ages. Then from the village of Nakabata there was the same distance over a plain covered with wild grasses and flowering herbs, intermixed with shrubs and a few stunted

trees, the soil composed more largely of ashes and getting coarser as we advanced, and with thinner vegetation. Then the ascent became more abrupt and we entered a wide belt of forest containing many varieties of trees, but none of large size. Further up there were shrubs, grasses, etc., many of them in flower and attracting many insects. A few species of plants went far up the ashy slopes, probably to a height of 10,000 feet.

Although I do not intend to give lists of the insects or to enter into particulars regarding the dates and localities of those captured (a few of which I have brought for your inspection), it may still be convenient to refer separately to the members of the various orders.

Neuroptera ; Pseudoneuroptera.—Walking up the Bund on the morning of the 12th of August, having just landed by sampan from the good ship Empress of India, I was at once interested in the number of dragon-flies, of two or three species, which darted to and fro along this fine promenade. The profusion of Odonata then indicated was noticeable throughout the country, and was doubtless due to the abundant opportunity for breeding offered by the wide-spreading rice-fields. These are always kept submerged, or at least partially so, and in addition there are numerous ponds and myriads of irrigation channels cutting the plains in all directions. Many of the species of Diplax, Calopteryx, Libellula, etc., were very handsome, and I much regret that I was able to bring back only a few examples, and these of the common species. The insects are called by the natives *tombo*, possibly from their hawk-like flight, as the name for the large kite which is so abundant near the cities is very nearly the same, viz., *tombi.*

Many other neuropterous insects were observed, with species closely related to those which occur in Canada, such as Caddis-flies, Laced-winged flies (Chrysopa), Scorpion flies (Panorpa), which were very common, Chauliodes, etc. Near Yokohama I twice obtained with sweeping-net several young specimens, about one-eighth of an inch long, of the curious larvæ (in shape like miniature stag beetles), of Ascalaphus, which is a relative of the ant-lions, but could not determine on what plants they had been, although I made a careful examination of the foliage. A species of white ant is quite abundant.

Orthoptera.—Of both terrestial and arboreal grasshoppers (Jap. *Batta* or *hata-hata*) large numbers were observed. The former are especially numerous in the cultivated plains, and upon the grass-covered mountains and wastelands such as occur in the Hakone district. The name *inago* is given to a species which is known as the rice-locust, and which is reported to do serious damage to the principal crop of the empire. One very common, yet striking, grasshopper was a slim, bright green species, nearly four inches long when fully grown; the head being elongated and the antennæ flattened. The outline of the insect is that of a blade of grass and the insects are very difficult to see when they are at rest among the grass, even on a closely cut lawn. Some specimens (apparently a variety of the same species) had a row of white dashes along the wing-covers and frequented grasses with such markings upon the blades. Along the paths between the fields and on the grassy hills I saw great numbers of a very large robust grasshopper, resembling very much the big American species called *Acridium americanum*, but belonging probably to a different genus. These large voracious insects must devour an immense amount of vegetation.

Very interesting both in appearance and habits, were the numerous members of the katydid and tree-cricket tribes, the dwellers in the trees and shrubberies, whose notes were very often piercing and prolonged. One large species was very frequently kept in little bamboo cages by the natives, but I cannot say that its song was very pleasing, although there was plenty of it. A pair kept near my brother's house used to shrill for long periods each evening, producing a noise which I at first took for the running of some machine, so loud and monotonous was the prolonged strain.

Another conspicuous insect was a large species of Mantis (Jap. *Kamakira* or *toro*) which was quite abundant. I frequently saw them devouring grasshoppers and other insects. The curious insects known as walking-sticks were abundant, as in this country, upon oaks, etc., and looked much like our species in the immature stages, in which alone I observed them.

Of crickets (Jap. *koriji*) there were big fat fellows in scores under any heap of weeds or rubbish; and cockroaches (Jap. *abura-mushi*) scuttled about the houses, which are sometimes much infested by them.

Dermaptera.—In Canada this order is represented only by the small and very rare *Labia minuta*, which is probably known only to entomologists. In Japan, however, earwigs were very numerous and swarmed among dead leaves, etc., and especially along the beaches among the windrows of cast-up sea-weeds. Some resemble greatly in appearance our own rare little species and probably belong to the same genus.

Hemiptera.—The Japanese name for bugs appears to be the same as that applied to insects in general, viz., *Mushi.* The bug *par excellence,* that species which, in not very remote regions of this country, makes the wooing of sweet sleep often more of a necessity than a luxury, is said to be unknown in Japan, and I certainly did not meet with it in any of my travels either on land or water.

The ponds and ditches contained water-bugs very closely resembling our species, including a Belostoma like the big water-bug which is seen so frequently upon our side-walks since the introduction of the electric lights. Of terrestrial Hemiptera there were numerous species of Reduviina, Capsina, Lygæidæ, Alydina, Pentatomina, Scutelleridæ, etc., some of the phytophagous species of which were so abundant that they must have done serious injury.

The members of the sub-order Homoptera were, however, much more noticeable because the large species of the Cicadidæ made such an outcry during the hot weather that the most indifferent person (unless afflicted with deafness) could not help being aware of them. The most vociferous species was a large smoky-winged Platypleura that was very abundant in Yokohama, and sent forth his loud, shrill *me-me-me* from every lawn and grove. There were also three or four clear-winged species of Cicada, with lusty voices which joined in the concerts, and added noise if not melody. The children caught numbers of these big bugs by means of slender bamboos with a little rice glue on the tip, and were very expert at getting them from their resting places in the trees. They also caught in the same way dragon-flies, for what purpose I know not, and an apparatus of this kind might often be of use to an entomologist for bringing down insects from otherwise inaccessible situations. The Japanese name for the Cicada is *Semi*, probably in allusion to its shrill notes.

Several species of small Fulgoridæ were taken, but I did not see any of the large Lantern-flies such as occur in China. A bright green species about two-thirds of an inch long was common, both young and full-grown, on lawn shrubbery. There were also various tree-hoppers and frog-spittle insects, of which some were very prettily marked and coloured. These were closely allied to Canadian forms, but there occurred also abundantly a handsome little insect belonging to the sub-family Ricaniida, which is unrepresented in North America. This pretty insect looks more like a little butterfly than a bug, as the wing-cases are expanded and held horizontally. They are of a brown color, with two transparent bars, and when the insect is alive they are covered with a rich irridescent bloom, and have each a sort of eyespot near the margin. Unfortunately the fine powdery coating rubs off very easily, so that my specimens have lost the greater part of their beauty, and do not so much resemble lepidoptera. A beautiful green bug, looking like a small moth with drooped wings, occurred in great numbers, at times forming a regular fringe on the stems of plants. When disturbed they slipped very cunningly around to the opposite side of the twig. This species belongs to the genus Ormenis.

Coleoptera.—Beetles are well represented in Japan, some of the species being exceedingly, and destructively, abundant. Many of the species are very large and handsome in comparison with those of the more boreal fauna of Canada, which is especially noticeable in such families as the Scarabæidæ and Lucanidæ.

Of tiger-beetles there was a very brilliant species, which was abundant near Yokokawa (about one hundred miles inland from Yokohama), and also at Chofu, near the Western entrance to the Inland Sea. It was of a rich green and blue colour with bands of ruddy gold or bronze across the thorax and elytra. Upon the upper slopes of Fuji (at perhaps 8,000

feet of altitude) I obtained several specimens of a Cicindela which was of the dark colour of the ashes among which it lives, and could be seen only when it was in motion, so closely did it agree in colour with the ground. The same species also occurred upon the volcanic mountain Asama, the slopes of which are likewise of dark ashes and scoriæ.

Of Carabidæ I captured very few specimens, but received several fine species from my brothers. I have seen no Carabids corresponding to our large species of Calosoma and only one Carabus, but some striking specimens of Damaster occur. These are elongate black beetles, with the elytra resembling those of some tenebrionids (Blaps), but with the thorax much elongated, and the legs very long, so that they must be able to run rapidly. Only one living specimen was seen by me. The other carabids observed were mostly Harpalus, Pterostichus and Amara.

Water beetles closely resembled Canadian ones and among them was a large Hydrophilus like *H. triangularis*. Staphylinidæ seemed to be very rare, and of carrion beetles the most common species was a large black Silpha. Coccinelidæ produced some very pretty "lady birds," but very few of the species were abundant.

One of the most brilliant beetles obtained was a fine green buprestis (a species of Chrysochroa) which is found not uncommonly in the mountainous regions of Nikko and Hakone, and probably infests the giant conifers which grow there so plentifully. In the same district occur fine species of Chalcophora, of which one is much like the *C. fortis* which lives in Canadian pine trees. The only other buprestid observed was a small species which occurred plentifully on grasses and flowering shrubs, and which is much like a small Brachys.

Of all the Coleoptera observed, the most tropical in appearance as well as the most bulky, was a giant Scarabeid (*Xylotrupes dichotomus*) which occurs abundantly in the districts above mentioned, and probably inhabits decaying specimens of the big trees. The male of this fine insect has upon his head a long horn, flattened and forked at the tip, and a shorter, notched protuberance upon the thorax, in which the long horn can rest when the head is raised. The beetles vary considerably in size, and large ones will measure two inches in length, and more than an inch in width; the horn on the head being one and one quarter inches long. The family Scarabæidæ was also rich in the flower-loving Cetonians, some species of which were so abundant as to be very injurious to vegetation. A green species about half an inch long swarmed in the fields near Yokohama, and destroyed especially the beans, which form an important crop.

A pretty mottled green Euryomia was in such swarms upon roses, altheas, etc., that all the flowers were eaten off before they could expand, and each bud would be the centre of a struggling group, which when disturbed buzzed about like a swarm of angry bees. Copris, Geotrupes, and other dung-beetles were numerous on the country trails where the packhorses had marked their passage.

The Lucanidæ, or Stag-beetles furnished two fine species of Lucanus, and also some good specimens in the genus Dorcus, probably of two species. These seem to be generally distributed, epecially in the wooded regions already quoted.

With such a rich and varied vegetation the leaf-feeding Chrysomelidæ were naturally rich in species and numbers. Many of the species were very pretty, and among the most common were some species of flea-beetles, one just like the little striped-wing turnip flea-beetle.

Next to the Scarabæidæ, the most interesting beetles were the Snout-beetles, or weevils (Rhyncophora). The Rhynchitidæ and Attelabidæ were especially well represented by very pretty species. Of Curculionidæ there were also numerous species, but as my specimens have not yet been mounted I do not know what they are. I only obtained one specimen of Balaninus, but found the acorns of some oaks to be greatly infested by larvæ of these nut-weevils.

Among the Japanese names for beetles are *Kogane-mushi* (gold-insects) and *Yoroi-mushi* (mailed insects).

Diptera.—The common house-fly is not in Japan the pest that it is found to be in America, and only in a few places did I notice more than occasional specimens. Other kinds of flies are, however, abundant, and some of them are large and showy, such as a large robber-fly (Asilidæ) with brilliant green eyes and a conspicuous tuft of white

pubescence at the tip of the abdomen. Large horse-flies (Tabanus) were annoying along some of the pack-horse trails, and I received quite a severe bite on the arm from one as I was returning from the ascent of Fuji.

The great areas of wet fields offered ample opportunity for the propagation of aquatic insects, and mosquitoes were therefore abundant, except in the higher mountainous districts. The common species is smaller than those of this country, and is nearly black with white markings on the legs. Its bite I did not find very severe, and they are troublesome only from their numbers, and the long period during which they abound. The native name for this insect is *Ka*, and the mosquito net which is used at night in all houses in infested regions is called *Ka-ya*, or mosquito-house.

Fleas were exceedingly abundant in all parts of the country I visited, and in the native houses where we slept on the floors we often had to make a liberal use of insect powder to insure a night's repose. They find good hiding places under the matting which covers the floor, but would not be so troublesome if bedsteads were used. (Jap. *Nomi.*)

Lepidoptera.—In this favorite order I saw many beautiful insects, the most conspicuous being the large black swallow-tailed butterflies, which flitted about the mountain roads and over the grassy plains, and hovered about the flowering shrubs such as the abundant Hydrangea. Of yellow papilios, however, I saw few specimens, but these were very similar to our common *P. turnus.* In the woods, which are often almost impenetrable from bamboo scrub, creepers, etc., were many fine Satyrids, Graptas, etc., and a pretty Limenitis having a pale blue band across the wing. The small blue butterflies were sometimes in immense numbers, as along the road leading across the plain from the foot of Fuji to Nakabata, where they rose in swarms from every moist spot. With these occurred also great numbers of bright sulphur-yellow butterflies (Colias). Of white butterflies there were fine large species, and I also saw flying in Yokohama examples of what I took to be the common white cabbage butterfly, *P. rapæ.* Skippers did not seem to be in any variety, but on the other hand there were some common butterflies quite unlike those of Canada. High up on one of the mountains, where the flora began to have a home-like appearance, I saw *Vanessa antiopa*, and I also saw on the wing what was apparently *Pyrameis atalanta.* The Japanese name for butterflies is *Chō*, and for the silkworm *Kaiko.*

Of moths I often saw very pretty specimens, but did not attempt to collect any, and cannot even say what groups were most abundant. It will not be out of place here, however, to make a few remarks on what is to Japan a most important species, viz., the silkworm moth, *Bombyx mori.* The rearing of silkworms and the manufacture of their products employ a large part of the population and contribute greatly to the prosperity of the country. The silk is produced chiefly in the central and western parts of the main island of Hondo, and in these regions enormous tracts of land are devoted to raising the various varieties of mulberry whose leaves supply food for the innumerable and voracious worms. In the Shinshiu provinces the extensive plains were almost covered by mulberry bushes, so that we saw little else from the car windows as we passed through them. At the flourishing city of Nagano, the chief town of the province, the shops contained enormous numbers of cocoons, and in almost every house along the neighbouring roads were displayed the same white objects heaped in trays and baskets. In each house also the women were busy reeling the silk from the cocoons with small hand wheels. The main production is by the spring brood, but in some localities there is also a summer one. I did not see any worms feeding at the time of my visit (the middle of Sept.) but saw the moths emerging from the cocoons. At various places in the country I saw large factories for the manufacture of silk (including one at Gifu, since destroyed by the great earthquake of 28th October), but the greater part of the silk is still, I believe, woven upon hand looms.

Hymenoptera.—I collected a fair number of insects belonging to this order, but have not since examined them. The honey-bee does not appear to receive much attention, and the only specimens I saw were at Nikko. All the honey used in Yokohama is obtained from San Francisco. Possibly the flora may not furnish a succession of nectar-bearing flowers sufficient to make the keeping of bees profitable.

Humble-bees appeared at first to be wanting, but later I saw a few species, but not many individuals of any. One very handsome species was velvety-black with the last two segments of abdomen red.

I took one specimen of a carpenter-bee (Xylocopa) very like our *X. virginica*, and two or three examples of a large, stout black Megachile (Lithurgus ?), the only leaf-cutting species almost which I observed. Species of Andrena, Halictus, Prosopis, etc., were more or less common.

Wasps were more abundant than bees, and a very large dark Vespa (*mandarina ?*) abounded both in Yokohama and in the country districts. Its nest was constructed of a coarse, heavy mottled paper made from bark, which I frequently saw the wasps obtaining from a maple tree on the lawn. The nest is of large size, and is built in trees, under the eaves of temples, etc. I saw two servants destroying a large one which was suspended in a small tree near the gateway of one of the "foreign" houses in Yokohama. One captured the wasps, which having been disturbed were crawling about on the nests, by means of a slender bamboo, with rice glue on the tip, and the other knocked them off and killed them as captured. When disturbed these wasps buzz around in a very alarming manner, and from their size have a very formidable appearance, but though often threatened I was never stung. A smaller black and white species was also common, but I did not see its nest.

Polistes were very numerous, and built their small exposed combs in the shrubs, especially in the closely-trimmed cedars, which give a good shelter. Fine species of Sphex, Pompilus, Ammophila, etc., were common, as were also Crabronidæ, Scoliadæ, etc. I only saw one Mutilla, which was captured in a very shady corner, near a small shrine embowered in camphor trees, and which gave me a sharp sting before I recognized what I was catching. The only other sting received while in Japan was from a stout black Scolia which I picked up in one of the temple grounds at Nikko, and almost dropped again. Did these insects think that their capture in such sacred precincts was an act of sacrilege deserving of instant punishment, and "Make the punishment fit the crime?"

Parasitic hymenoptera seemed to be less numerous than the stingers, and I obtained but few specimens of ichneumons and braconids, although a few fine species of Pimpla, etc., were seen. It was perhaps too late in the summer for these insects, as there seemed to be very few larvæ feeding to be attacked by them. In the Ueno National Museum in Tokio I saw an interesting braconid with an ovipositor about twice as long as that of our large *Thalessa atrator*, although the insect was smaller. The insect collection in this museum embraced all orders, but was a small one consisting only of a few cases.

Chalcids and Proctotrupids were very rare, although I kept a good look out for them, especially when using my sweeping net. One fine species of Smicra was common, especially about shrubs on the lawn and on some of the rows of broomcorn, which are planted on the margin of fields, and which sometimes attract many hymenoptera and diptera to feed on their exuding juice.

Saw-flies were at first abundant, especially when I was in the Hakone district, but it was late in the season for them, and they rapidly disappeared I noted some interesting larvæ, especially a large one somewhat like the larva of Cimbex, but having a row of fleshy spines along the back. Gooseberry and rose bushes suffer as they do here, and I saw on willow leaves globular galls of Nematus almost like those seen upon our Canadian trees. Some of the galls also contained, as they do here, inquilinous weevils (a small black Apion).

In conclusion, I may say that Spiders were numerous, some of the species being very large and handsome and constructing gigantic webs. Some of the species were also very curious, especially those with thin attenuated bodies, in shape like young walking-sticks, and green or black in colour. Ugly looking Centipedes, three or four inches long, occur under rubbish, etc., even entering the houses, and are said to be venemous.

The observations and collections (not yet mounted or studied) which form the subject of this very hastily prepared, and, therefore, very fragmentary paper, were made between the 12th of August and the 22nd of October.

THE MOOSE FLY—A NEW HÆMATOBIA.

BY WM. A. SNOW, UNIVERSITY OF KANSAS, LAWRENCE.

Entomologists will be interested to learn of the occurrence of a near relative of the Horn Fly, *Hæmatobia serrata*, in the middle of the great cranberry swamps of Northern Minnesota. These vast low areas extend for hundreds of square miles in the vicinity of the Lake of the Woods. They are the favoured home of the American moose, and the hope of obtaining some specimens of this animal for the museum of the University of Kansas, led Professor L. L. Dyche of that institution to traverse these dangerous marshes. Professor Dyche has recently returned after remaining for over three months in the very centre of the swamps, camping upon the occasional sand ridges which cross the region; and to him I am indebted for specimens of a new *Hæmatobia*, which I have named *H. Alcis.*

The flies were noticed first upon skinning the first moose, when a number of them were discovered in the animal's rectum, into which they had crawled for two or three inches in order to deposit their eggs in the excreta. The dejecta upon the ground were also found to contain hundreds of the eggs. Altogether nineteen moose were killed, and in almost every case these flies were observed about them, remaining upon their carcasses as long as they lay unskinned, which was often twenty-four to thirty hours. For some time after the death of the animal, the *Hæmatobiœ* could be seen only with difficulty, concealed as they were by the mosquitos, which were incredibly numerous, lingering in clouds upon the dead moose as long as any of its juices could be extracted. The flies seemed to prefer the regions of the head, rump and legs, where the hair is shortest. It is highly improbable that they find a resting place upon the horns of the moose. The male moose go thrashing about in the underbrush with tremendous energy. They use their horns during a great part of the year to scrape away the bark from trees; and they have a way of winding them in among the bushes when a rival is near, as a challenge. The females, as is well known, have no horns. The present species is very probably indigenous, infesting as it does an animal not in domestication; and inhabiting such secluded inland portions of this continent. The moose obtained by this expedition were all killed far within the swamp, fifteen to twenty miles from firm land; and it is only in such places that this now rapidly disappearing animal can be found. This region is rarely visited by white men, and the few Indians that venture there wait until the surface of the fens is frozen over. It is not altogether unlikely that this fly infests the caribou also. It was hardly possible to observe its actions on the living moose; but we know that it lays its eggs in the excrement, and in all probability it resembles *H. serrata* in other habits as well.

Professor Dyche heard no complaints from owners of stock on the borders of the swamp of the ordinary Horn Fly, or of any similar fly. The cattle are, however, tormented with mosquitos, and smudges are kept constantly burning to which they may run for relief.

OBITUARY—HENRY EDWARDS.

This well-known and highly-esteemed entomologist died at his home in New York City, at 1.30 a.m., on the ninth day of June, 1891. His death was caused by dropsy and other complicated troubles, which affected the heart.

In him the world has lost an earnest devotee to science and art, and those who knew him, a kind-hearted, generous, true and sympathising friend. In his death, entomological science has lost one of its most active and energetic workers, and his loss is deeply felt and deplored by all who knew him, and he has passed out of this earthly domain with the affectionate regret of many grateful and loving friends.

Mr. Edwards was born in Ross, Herefordshire, England, August 27th, 1830, and was destined by his father to become a lawyer. After studying for some time without evincing any particular aptitude for the profession, he entered a London counting house, and frequently appeared in amateur theatricals, for which he had much talent. He finally

decided, much against the wishes of his parents, to adopt the professional stage. In 1853 he embarked for Australia, where he made his first appearance as an actor, and where he passed many prosperous years. From Australia he drifted to Peru and Panama, and in 1867 he reached, San Francisco, California. In about 1877 he made his first appearance in the east, at Boston, and finally in 1879 he came to New York. In 1889-90 he again visited his old home in Australia, from where he returned last year. During all these years he was constantly connected with the stage, until only a short time previous to his decease, when he was compelled to retire on account of his illness. At the time of his death he had just returned from a trip to the Catskill Mountains, where he was staying for his health, and three and a half hours later he entered into rest and the everlasting silence.

As an entomologist Mr. Edwards was world-known, and was considered one of the greatest authorities of the science, to which he was attached ever since his boyhood days. He was chiefly known by his excellent papers on the Pacific Coast Lepidoptera, which contain the descriptions of many new and interesting species from that region. He was also known by his articles on North American Ægeriadæ, of which family he described nearly all our American species. Besides these papers he has also written many other articles on descriptions of new species and transformations of Lepidoptera. He also edited three volumes of the journal "Papilio." The last large work he published was his "Bibliographical Catalogue of the Described Transformations of North American Lepidoptera," which is now in the hands of all our working entomologists. Mr. Edwards spent much money for the increase of his collection of insects, and devoted all his leisure time to his favourite study. His travels afforded him many rare opportunities for collecting material for his collection and writings. The collection consists of about 300,000 specimens of insects of all the orders from all parts of the globe. It contains the types of all the species he described, about four hundred and fifty, except a few which are in other collections. It also contains a number of Grote's types of Noctuidæ and Pyralidæ, and many of Fish's types of Pterophoridæ, and types of other writers. It contains also the unique pair of *Oniticellus californicus*, and many other uniques, oddities and rareties of considerable value. The collection is one of the largest private collections in the world. His library consists of about five hundred volumes of entomological works, and about double the number of pamphlets, and about two thousand volumes on travels and other topics. (I am not sure about these figures.)

Mr. Edwards belonged to many scientific and other societies. He was for some time vice-president of the California Academy of Sciences, life-member Brooklyn Entomological Society, member of the Torrey Botanical Club, Players' Club (New York), Bohemian Club (San Francisco), corresponding member Boston Society Natural History, San Francisco Microscopical Society, San Diego Natural History Society, Belgium Natural History Society, etc.

He leaves a widow who deeply mourns his loss, and we would here add our condolence and sympathy and heart-felt regret to her irreparable bereavement.

WM. BEUTENMULLER.

BOOK NOTICES.

INSECTA: By Alpheus Hyatt and J. N. Arms. Boston: D. J. Heath & Co.

This handy volume forms the eighth of the series of the "Guides for Science Teaching," issued by these well known publishers of educational works. The series is intended for the use of teachers who wish to give practical instruction to their classes in Natural History. The volume before us forms a marked advance upon those previously issued, inasmuch as it consists of 300 pages, with over 200 illustrations, while none of the others was more than a fourth of these dimensions. This great enlargement is due, no doubt, to the growing popularity of Entomology as a subject for the teaching of observation in schools, as well as for intelligent recreation and serious study on the part of individuals.

The volume before us is an admirable manual for teachers who wish to instruct their pupils in the science of Entomology, and will be found most useful also by private stu-

dents. It is full of admirable diagrams and illustrations, for the most part original, and it takes up for discussion some of the commonest insects in the different orders that can be readily procured by any one. For instance, the external structure and the internal anatomy of insects are first taught by means of the common locust (*Caloptenus*), which can be taken in quantities anywhere; a May-fly (*Ephemera*), a Dragon-fly, a Cockroach, a May-beetle, the *Archippus* butterfly, etc., are used to illustrate the different orders. No teacher or student need be at a loss for material with which to follow out the instructions in the book. The whole book is excellent, and we have no doubt that it will be found most valuable in the various agricultural colleges especially, as well as in other educational institutions.

We may quote the following advice from the opening chapter :— "Encourage children to watch living locusts.... Better a child should learn to handle one animal, to see and know its structure and how it lives and moves, than to go through the whole animal kingdom with the best text-book, under the best teacher, aided by the best charts ever made. The former would have learned what real knowledge is and how to get it, while the latter would have simply learned how to pass at his school examinations."

C.J.S.B.

AMONG THE MOTHS AND BUTTERFLIES: By Julia P. Ballard. G. P. Putnam's Sons, New York; pp. 237, 1890.

This beautiful book is an enlarged and revised edition of "Insect Lives," published in 1880, and contains recent studies and many additional illustrations. It treats especially of rearing butterflies, sphinges and moths from the caterpillars,and is based wholly on the personal observations of the author. Without previous knowledge of entomology, Mrs. Ballard found herself attracted by some species of caterpillar, and followed it up to pupa and imago, making original discoveries at every step, and gaining experience day by day, she has become an expert in that line. Many of the species treated of, if their earlier history is mentioned at all in books, have never been so carefully studied as here; witness the story of the Great Leopard Moth, the Bulrush Caterpillar, the Monkey-faced Moth, the Beechnut Box, the Rosy Dryocampa. Of many others, better known than these, there are interesting notes, as *Orgyia lencostigma*, *Deilephila lineata*, *Cerotocampa regalis.* The enthusiasm of the authoress is contagious, and makes the reader wish that spring would hurry along. I do not know of any book—certainly there is none in America—which has attempted to enter the field now taken possession of by Mrs. Ballard. If any good pater, or aunt, or cousin, wishes to do a good turn to an active boy or girl, they could not do better than put this book in the young person's hand—at the same time a net and collecting apparatus (which our good friend John Akhurst will be happy to furnish), and bid them, when spring comes, search the fields and woods as Mrs. Ballard has done. The difference between eyes and no eyes is wonderful, and occupying the former will keep young people out of mischief, at least giving them something to do and to think of. Once let a boy put his foot over the threshold of this temple of ours and catch a glimpse of the inner mystery, and there will be no idle and wasted hours. And to this end the authoress of "Moths and Butterflies" has well served her generation.

W. H. EDWARDS.

MANUAL OF ANIMALS INJURIOUS AND BENEFICIAL TO AGRICULTURE: By Dr. J. Ritzema Bos, Lecturer at the Agricultural College of Wageningen, Holland. Berlin, 1891.

This magnificent volume in German makes one wish that English-speaking farmers and gardeners, as well as Entomologists, possessed in their own language, and for their respective countries, a similar compendium of knowledge on the "Animals injurious and beneficial to agriculture, Cattle-breeding, Forestry and Horticulture."

This work of 876 pages contains all the information necessary concerning the forms, occurrences, life history in relation with man of his various animal friends and foes, and the curative and preventive measures against their attacks. The newest discoveries of

workers in this field, and original researches by the author are recorded, and 477 figures, engraved with scientific accuracy, show the appearance of the different mammals, birds, insects, snails, and worms, the details of their structure, and many devices for resisting the injurious kinds or assisting those that war against the latter and are thus precious allies of the farmer and gardener,

The first 30 pages are devoted to considerations on the causes of occurrence of obnoxious animals, and on the general means of protection against them. Then 80 pages treat of mammals from the bear to the mouse and the bat, 120 of birds, 460 of insects, 130 of snails and worms. The depredations of insects, which have been particularly studied by Dr. Bos, are especially dwelt upon.

At the end of the book are tables of the animal pests arranged according to the place where they live. This table is most useful, for, with its aid, anyone who has found any form of animal life preying on man, cattle, domestic animal, tree, or plant, or in granary, barn, or house, and wishes to know its name, habits, the nature of its ravages, the remedies against it, etc., can with very little trouble find the page in the volume where the desired information is given.

For instance, the first item of this table is as follows, with reference for each animal to the page in the book :—

Bee, bee hive :—Foxes, marten, polecat, bear, honey-buzzard, tits, occasionally other bird species ;—spiders ;—wasps ;—the brown bee louse (*Braula cæca*, a winged louse) ;—the so-called black bee louse (larva of an oil beetle), which, however, leads usually its cuckoo life only in wild bees' nests ;—bee moths, wax moths ; bee-beetles ;—earwigs.

Similar lists follow for cat, cattle, dog, domestic birds and eggs, goat, horse, man, pig, rabbit, sheep.

The references to apple tree pests are arranged under the different heads : In roots, in wood, under bark, in bark crevices, on and in buds, on young shoots, on one year's twigs, on buds and leaves, in the fruit, ravagers of the fruit ; and similarly for all common trees and plants of field, garden, or forest. J. A. Guignard, Ottawa.

Annual Report of the Experimental Farms : Ottawa : p.p. 314 ; 1891.

The Director of the Experimental Farms of the Dominion of Canada has recently issued his report for last year, and a very interesting "blue book" it is. The record of experiments with two-rowed barley is particularly valuable and important at the present time, and concerns everyone who is interested in the welfare and prosperity of this province. The reports of the Agriculturist, who treats especially of dairying, of the Horticulturist, Chemist and Poultry Manager, are all useful and instructive ; but the one which especially interests us is, of course, that of the Entomologist and Botanist, Mr. James Fletcher. His share of the report occupies over fifty pages, and is illustrated by some wood cuts of noxious insects, and nine beautiful full-page plates of various useful grasses. The insects treated are the American Frit Fly (*Oscinis variabilis*), the Cabbage Maggot (*Anthomyia brassicæ*), the Diamond-back Moth (*Plutella cruciferarum*), whose larvæ attack the leaves of cabbages. the Mediterranean Flour Moth (*Ephestia Kuhniella*), the Pea Weevil (*Bruchus pisi*), the Strawberry Weevil (*Anthonomus musculus*), and the Vancouver Island Oak Looper (*Ellopia somniaria*). In each instance Mr. Fletcher fully and carefully describes the mode of attack, and then gives the most satisfactory remedies, It is hardly necessary to tell our readers, who are familiar with Mr. Fletcher's work, that these articles are as complete and accurate as is possible in a limited space. It is very cheering to find that the mill that was so badly infested with the *Ephestia* moth year before last (of which the writer was an eye-witness), has been completely cleared of the pest by scrupulously carrying out, though with no little labor and expense, the directions of the entomologist. In spite of this example, it is surprising to find that the proprietors of other mills and feed stores in the same city are too apathetic and careless to take any measures to exterminate this insect when it appears on their premises. They will soon find that such neglect means utter ruin to their business, unless they take warning in time. The remainder of Mr. Fletcher's report is almost entirely devoted to the subject of grasses, of which he has been cultivating for the sake of experiment over a hundred different kinds. C. J. S. B.

THE BUTTERFLIES OF NORTH AMERICA: by W. H. Edwards. Third series; Part XI.

It is hardly necessary to do more than chronicle the issue of a new part of this magnificent work. The beauty and accuracy of the plates, and the excellence and value of the descriptive letter-press are too well known to need any further commendation. The part now before us illustrates and describes the complete life history, in all its stages, of *Apatura flora*, Edw. *Satyrus Meadii*, Edw., *Chionobas chryxus*, Doubleday, with its variety, *Calais*, Scudder. The last mentioned species is of peculiar interest to us, as it is found throughout the Rocky Mountains from Colorado to Canada. A most graphic account of its habits is given by Mr. Bruce, who has observed the insect for several years past. Why is it that *every* North American lepidopterist does not possess himself of a copy of this noble work? It can hardly be the cost, for the numbers appear at such long intervals that a very little self-denial even on the part of the impecunious would suffice for their purchase. While the subscriber would get a joy and treasure for life, let him think what a gratification and help it would be to Mr. Edwards to have his subscription list trebled, as it should be.

C. J. S. B.

BIBLIOGRAPHICAL CATALOGUE OF THE DESCRIBED TRANSFORMATIONS OF NORTH AMERICAN LEPIDOPTERA; being Bulletin No. 35 of the United States National Museum, by Henry Edwards, 1889.

This work, issued by the Smithsonian Institution, is one of very great value to the working lepidopterists of North America, and truly supplies a long-felt want. Mr. Edwards, who has devoted so much time to the compilation of this work, is entitled to the warmest gratitude of his brother entomologists for his public-spirited labours in this connection. The work extends to 147 pages octavo, and comprises a table of the number of species in each family, of which descriptions of earlier stages are recorded in this catalogue, a list of the principal authors and publications quoted, the body of the catalogue extending from page 9 to page 137 inclusive; an appendix giving references to a few species which are not distinguishable by modern authors, and a list of some of the most valuable papers which have been published on this continent on the subject of preparatory stages, food plants, rearing and describing larvæ, etc., etc. Then follows an index to genera, and the work ends with a most useful food habit index. The general plan of the work is to give the names of all species of which any of the preparatory stages have been described, followed by the references to these descriptions in the order in which they are published, the dates of publication being given. Upon turning to any species one can thus see at a glance just what of its earlier stages have been described, and by looking up the references can tell whether or not they could be supplemented with advantage, while the absence of any species from the list is a very sure indication that its preparatory stages are wholly undescribed. One can thus see just what has already been done and what remains for investigation, and this is most important, for it is undoubtedly the case that many observations of interest and value are made every year without being published, chiefly, perhaps, because those who make them are unaware that they have not previously been given to the world. The amount of literature examined in the preparation of this work was very great, and the care necessary to avoid errors and omissions proportionate. The table on page seven shows that some part of the earlier stages of 1069 butterflies and moths have been described, but many of these descriptions are very incomplete, and we can thus see how much still remains to be done in working out these life histories. Of course in a work of this kind, where the field was so large, it was inevitable that some mistakes and omissions should occur, but it is most creditable to Mr. Edwards that they should be so few and so unimportant. It was unfortunate that the printing had to be done during the absence of Mr. Edwards in Australia, as otherwise most of the typographical errors would unquestionably have been detected and corrected. It is, however, a mistake to refer to author's separates, instead of to the work in which the description originally appeared, as for example in regard to the larva of *Chionobas Macounii*--the reference given is "J. Fletcher, a trip to Nepigon, p. 12," whereas it ought to be, "J

Fletcher, Rep. Ent. Soc., Ont., 1888, p. 85." It is greatly to be hoped that Mr. Edwards will be able to fulfil his promise to issue yearly supplements, in order that the work may be kept up to date and its usefulness be thus maintained. The price of this work was fifty cents, but the first edition has already been exhausted. It is greatly to be hoped that a new edition will soon be issued, as no working lepidopterist can get on without it.

H. H. LYMAN.

INSECTS AND INSECTICIDES, by Clarence M. Weed. Hanover, N.H., 1891.

Under the above caption Dr. Weed has published a small volume of 281 pages, well printed and copiously illustrated, which will be found most useful by those for whom it is prepared, the farmer, the fruit-grower, the floriculturist and the housekeeper. The work consists of an introduction and six parts. The introduction gives a concise account of the transformations of insects, which are illustrated by the life history of *Papilio Asterias*, the Celery Caterpillar, for those which have a complete metamorphosis, and the Chinch Bug for those who pass through incomplete transformations. The differences between biting and sucking insects are explained, and the natural enemies of injurious insects are treated of. There is then a summary of the different insecticides and the best methods of applying them. The introduction closes with short instructions for collecting and preserving insects.

PART I. treats of Insects affecting the Larger Fruits—apple, plum, pear, cherry, peach.

PART II.—Insects affecting Small Fruits.—Strawberry, currants and gooseberries, raspberry and blackberry, grape.

PART III.—Insects affecting shade trees, the rose, and house-flowers. Parts I. and III. of Dr. Weed's work have appeared previously in a small edition issued by the Columbus (Ohio) Horticultural Society.

PART IV.—Insects affecting Vegetables.—Tomato, potato, celery, squash, cucumber, bean, pea, cabbage, onion, asparagus and rhubarb.

PART V.—Insects affecting Cereals and Forage Crops—Indian corn, wheat, clover, grass.

PART VI.—Insect Pests of Domestic Animals and the Household.

On the whole this is a very useful and attractive volume, well arranged, easy of reference and well illustrated. The accuracy and quality of Dr. Weed's scientific work are now too well-known to need any comment further than to say that this, his last publication, is up to his usual excellent standard.

J. F.

TWENTY-THIRD ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF

ONTARIO

1892.

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY.

TORONTO:
PRINTED BY WARWICK & SONS, 68 AND 70 FRONT STREET WEST.
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TWENTY-THIRD ANNUAL REPORT

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ENTOMOLOGICAL SOCIETY OF ONTARIO

To the Honorable the Minister of Agriculture:

SIR,—I have the honor to present herewith the annual report of our Society for its twenty-third year under the auspices of the Department of Agriculture of Ontario.

The report contains an account of the proceedings at our annual meeting, which was held in London on the 31st of August and the 1st of September, 1892—including the election of officers for the ensuing year, the reports of the Council, the Treasurer, the Librarian and Curator, the Montreal branch and the various Sections of the Society, the President's annual address and the various papers read at the meeting.

The President's address will be found to contain references to all the principal insect attacks of the year. Most of these were, happily, not very formidable, but we regard the arrival from the United States of the Horn-fly pest, during the past season, as a very serious matter. In addition, therefore, to the President's remarks upon it, an illustrated account of its life-history and the best methods of dealing with it has been specially prepared for the report by Mr. Fletcher. Other papers of a practical and more or less popular character are also presented herewith, and will, it is trusted, be found interesting and useful to the general reader.

Our monthly magazine, the *Canadian Entomologist*, has been regularly issued during the past year, and has now almost completed its twenty-fourth volume. A larger number of writers than ever before have contributed to its pages, and its high scientific character has been ably maintained.

I have the honor to be, Sir,

Your obedient servant,

W. E. SAUNDERS,

Secretary.

ANNUAL MEETING OF THE SOCIETY.

The thirtieth annual meeting of the Entomological Society of Ontario was held in its rooms in Victoria Hall, London, on Wednesday, August 31st, and Thursday, September 1st, 1892, the President, Rev. C. J. S. Bethune, Port Hope, occupying the chair.

A Council meeting was held on Wednesday morning at 10 o'clock, at which their annual report was drawn up, and various matters of business pertaining to the society were transacted.

At 3 p.m. a general meeting of the Society was held. Letters of regret for their inability to attend were read from Messrs. H. H. Lyman, Montreal; A. H. Kilman, Ridgeway; J. D. Evans, Sudbury; Gamble Geddes, Toronto. A letter was read by Mr. Moffat from Mr. F. G. Buckell, of London, England, upon the expansion of the wings of Lepidoptera with reference to Mr. Moffat's paper upon this subject in the annual report for 1891, p. 32. A letter was also submitted by Mr. Harrington from the Rev. G. W. Taylor, of Victoria, Vancouver Island, stating that Aphides of all kinds had been extremely abundant during the present season, but that they had been very much parasitized by Hymenoptera.

REPORT OF THE TREASURER.

The Treasurer, Mr. J. M. Denton, presented his annual statement of the finances of the Society and explained the various items of receipts and expenditure. He stated that the balance on hand, $319.13, was somewhat larger than usual, but it would all be required to meet the expenses of the remaining four months of the year, during which there was very little income to be expected.

RECEIPTS, 1891-92.	
Balance from last year	$ 239 93
Membership fees	335 22
Sales of *Canadian Entomologist*	99 44
" Pins, Cork, etc.	47 18
Government grant	1,000 00
Interest on current account	3 55
	$1,725 32

EXPENDITURE, 1891-92.	
Printing *Canadian Entomologist*, etc.	$ 509 77
Report and meeting expenses	226 12
Library	44 25
Purchase of collection	50 00
Expense account (postage, stationery, etc.)	107 54
Rent and fuel	116 00
Insurance	35 00
Pins, cork, etc	17 51
Salaries of officers	300 00
Balance	319 13
	$1,725 32

Audited and found correct,

(Signed.) W. E. Saunders, Jas. H. Bowman, } Auditors.

London, Ontario,
August 30th, 1892.

REPORT OF THE LIBRARIAN AND CURATOR.

Mr. J. A. Moffat presented and read his report as follows :

The number of volumes added to the library during the year is 46, made up thus: Periodicals and reports of Societies received in exchange, which have been bound since last report, 37. Bound volumes which have been received as gifts from various public institutions, 8. By purchase, 1. The whole number on the register is now 1,214.

The number of volumes issued to local members during the year was 55.

The Society's collection of native Lepidoptera has received several valuable additions by gift, exchange and capture. This department now numbers 935 species and varieties, mostly taken in Ontario.

The Toronto list of 1883 contained 930 names, many of which were not then, and some of them not yet represented in the Society's drawers. Six or seven years ago when I first turned my attention to the micros there were not a hundred names of these in all our lists, now there are representatives of two hundred and twenty-four species in the Society's drawers, and a quantity of unnamed material on hand besides. It is quite evident that our field in Ontario is not half worked, whilst some of those that are engaged in it fail to make their success known.

The arrangement of the European beetles has been completed, and they occupy fourteen drawers, numbering 952 species. There is a large number of duplicates for disposal; some of them are very attractive specimens.

Respectfully submitted,

(Signed.) J. Alston Moffat,
Librarian and Curator.

REPORT FROM THE ENTOMOLOGICAL SOCIETY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA.

By the Rev. C. J. S. Bethune, D.C.L., Delegate.

On behalf of the Entomological Society of Ontario I have the honor to report that it continues to prosper and to perform much useful work. During the past year the ordinary membership was well maintained, while the number of associate members (who are not resident in Canada) was largely increased.

The *Canadian Entomologist*, the monthly publication of the Society, continues to attract contributions from all the leading Entomologists of North America, and to maintain its well established reputation. The 23rd volume was completed in December last, and consisted of 292 pages, instead of the usual 240. Its contributors numbered fifty-one, of whom fourteen were residents of Canada ; thirty-five, of the United States ; one, of England ; and one, of Germany. No less than sixty-one new species of insects were described in its pages, and the life histories of twenty-one species were recounted. Among the more important papers, besides those of a descriptive character, may be mentioned, "Notes on Canadian Rhyncophora," by W. H. Harrington ; "The Position of Limenitis Proserpina," by W. H. Edwards ; "Notes on Coleoptera," by Dr. J. Hamilton ; "Silver-top in Grass and the Insects which may produce it," by H. Osborn ; "Some Indiana Acrididæ," by W. S. Blatchley ; "North American Chernetidæ," and "The Dysderidæ of the United States," by Nathan Banks ; "Some Destructive Locusts of North America," by Lawrence Bruner ; "A Catalogue of the Thysanoura of North America," by A. D. Macgillivray ; and the official report of the meeting in Washington of the Entomological Club of the American Association for the Advancement of Science.

Five numbers of the 24th volume have been issued during the current year, each of them with an increased number of pages ; fifty-nine new species of insects have already been described, and several papers of more than ordinary value and interest have been published.

In addition to the monthly magazine, the Society presents an annual report to the Legislature of Ontario. The 22nd was published by the Department of Agriculture in January last. This report for 1891 contains an account of the proceedings at the annual meeting of the Society, the President's annual address and the reports of the officers, the Montreal Branch and the Sections, and the papers read on the occasion.

The President in his address drew the attention of the Society to the most serious insect attacks of the year, and gave an account of the ravages of "the Eye-spotted bud moth" (*Tmetocera ocellana*), "the Lesser Apple-Leaf Folder" (*Teras minuta*), "the Oblique-banded Leaf-roller" (*Cacœsia rosaceana*), "the Canker-worms" (*Anisopteryx vernata* and *pometaria*), "Cut-worms," the "Pea-weevil" (*Bruchus pisi*), "the turnip flea-beetle," "the Striped Cucumber Beetle" (*Diabrotica vittata*), and other more or less injurious insects. Among the papers published in the annual report may be mentioned the following: "Can Insects Survive Freezing?" and "Pamphila Manitoba and its Varieties," by Mr. H. H. Lyman; "*Nematus Erichsonii*," the Larch Saw-fly, whose destructive ravages among the tamarac swamps of the Province of Quebec are fully related by the Rev. T. W. Fyles; "a Microscopical Examination of an Unexpanded Wing of *Callosamia promethea*," by Mr. J. A. Moffatt; "an Account of some of the Collections of Insects in England and Germany," by Capt. Gamble Geddes; "the Northern Mole Cricket," by Mr. J. Fletcher; "Notes on Japanese Insects," by Mr. W. H. Harrington; "The Moose Fly," by Prof. W. A. Snow.

The various Sections of the Society, which were organized about two years ago, report very satisfactory progress. The Ornithological Section state that their "membership while not large is enthusiastic;" they have prepared a list, which is published in the annual report, of 97 birds known to breed in the county of Middlesex, Ontario, and of 20 other species observed in the same neighborhood and which will probably be found breeding there. The species are distinguished into those which are decidedly beneficial on account of their feeding habits, those which are neutral, and those which are open to doubt as being possibly injurious.

The Microscopical Section have held numerous regular meetings and several popular exhibitions; the subjects to which their attention was chiefly devoted were the manipulation of the microscope and the preparation of objects, and the examination of *algæ*, *fungi*, including the destructive Black-knot on fruit trees, ferns, etc.

The Botanical Section held weekly meetings throughout the greater part of the year, and have begun the formation of a collection of native plants, which is deposited in the rooms of the Society; a floral calendar has been kept; two mosses new to Canada have been discovered, and seventy species of fungi have been added to the North American list.

The members of the Geological Section have held evening meetings every week, at which they applied themselves to the serious and methodical study of the science, and when the season admitted, frequent field-excursions were made for practical work. During these they covered a large area of country and gathered many rare and valuable specimens of fossils.

The formation of these Sections of the Entomological Society for the encouragement of work in other departments of science, has thus been amply justified. The results have been most satisfactory, and the cheerful assistance given by the members of one section to those of another has been most useful. While occupying widely different fields of study they are constantly brought into contact with one another and find the benefit of co-operation as members of one Society, as well as the advantage to be derived from its library and rooms, and complete organization. The result is to make London, the head-quarters of the Society, a centre of scientific work for the peninsula of Ontario, and to attract its residents, especially the young, into the delight-giving paths of Natural Science.

The annual report of the Society contains also a full record of the very important meeting of the Association of Economic Entomologists held in Washington in August last under the presidency of our colleague, Mr. James Fletcher, of Ottawa. This Society was

first organized in Toronto in 1889, and has already become a very influential body, including amongst its members all the leading scientists in North America who are engaged in the study of practical Entomology. Its proceedings are accordingly of great scientific value as well as of immense practical value to farmers, gardeners and fruit-growers everywhere. The President, in his opening address, drew special attention to the want of reliable statistics concerning the ravages of destructive insects and the consequent financial loss to the community; a committee was accordingly appointed to prepare a report upon the subject. During the meeting, which occupied two days, a large number of papers on injurious insects were read and discussed, and much useful information was thus brought forward and made public.

While technical investigations in Entomology are by no means neglected, it is evident that our Society is becoming increasingly devoted to practical work, and is thus conferring very great benefits upon the agricultural interests of the country. Every fruit-grower and gardener is obliged to wage unceasing war against the infinite variety of injurious insects, and he can only do so with any hope of success when he has been taught by experienced scientists what methods to adopt and what means to employ. The publications of the Society from year to year set forth the best methods, and furnish instruction as to the best means for carrying on this warfare. The good work thus done will, we trust, be continued with unflagging zeal in the future.

The President gave an account of the meetings held at Rochester, N.Y., during the third week of August, of the Association of Economic Entomologists of North America and the Entomological Club of the American Association for the Advancement of Science, which he and Mr. Fletcher had attended as representatives of the Society.

The Rev. T. W. Fyles read a paper on *Zaraea Americana* which he found feeding on the Buck Bean, *Menyanthes trifoliata*. He also read an interesting account of some of the rarer butterflies found in the Province of Quebec. Mr. Fletcher remarked upon the paper and gave some further information regarding the life-history of some of the species referred to.

Mr. Fletcher then gave an account of a parasite of the Currant-worm. This, he described, as an exceedingly small insect which lives inside the egg of the Saw-fly, from which the Currant-worms hatch. He also mentioned that two species of Mud-daubers (*Pelopœus cementarius* and *cœruleus*) had been bred by him from the same mud nest.

The Rev. T. W. Fyles gave a most interesting account of a visit which he had paid to the home of the late Philip H. Gosse, author of the "Canadian Naturalist," who resided many years ago near Compton, in the Eastern Townships, P.Q.

The meeting adjourned at 5.45 p.m.

EVENING SESSION.

In the evening the Society held a public meeting in its rooms in Victoria Hall which was largely attended by members and other friends from London and the neighborhood, amongst whom the following were noticed: Mr. W. H. Harrington (Vice-President) and Mr. James Fletcher, of Ottawa; Rev. T. W. Fyles, South Quebec; Messrs. J. M. Denton, W. E. Saunders, J. Alston Moffat, J. A. Balkwill, R. W. Rennie, F. W. Hodson, John Weld, W. Stevenson, H. Stevenson, J. H. Bowman, J. Dearness, Dr. Gardiner, Rev. W. M. Rogers, Dr. Woolverton, C. B. Edwards, W. Foot, of London and others.

THE PRESIDENT'S ANNUAL ADDRESS.

The Rev. Dr. BETHUNE, Warden of Trinity College School, Port Hope, President of the Society, took the chair at 8 o'clock, and proceeded to deliver his annual address, as follows :

GENTLEMEN : The pleasant duty once more devolves upon me of welcoming you all to our annual meeting. It is with great gratification that I do so, inasmuch as all goes well with our Society, and the reports of the council and officers, and also of the sections, record a steady progress and a continued prosperity. It is now thirty years since Mr. Saunders and I issued a circular to the collectors of insects in Canada, who were at that time very few indeed in number, and by this means obtained the names and addresses of all who were interested in Entomology. After some correspondence had taken place, it was decided to call a meeting at Toronto for the purpose of forming a Canadian Entomological Club. A meeting was accordingly held in the rooms of the Canadian Institute in Toronto, on the 16th day of April, 1863, at which nine gentlemen were present, and resolutions were drawn up for the formation of "The Entomological Society of Canada." It will interest you, no doubt, to hear the names of these pioneers of the science in this country. They were the Rev. Prof. Hincks and Prof. Croft, of the University of Toronto ; Mr. J. H. Sangster, Dr. Beverley R. Morris and James Hubbart, of Toronto ; Dr. Thos. Cowdry * and his son, Mr. H. Cowdry, of York Mills ; Mr. Saunders, of London, and myself. We had also letters of sympathy with the project from Mr. E. Billings, of the Geological Survey, Montreal ; Mr. R. V. Rogers, Kingston ; Mr. F. Reynolds, Hamilton ; Mr. B. Billings, Prescott ; Rev. V. Clementi, Peterborough ; and Mr. E. Baynes Reed, of London. These gentlemen all co-operated very heartily in the work of the Society and largely contributed to its success. From this beginning of fifteen members the Society has gone on, grown and prospered, and it has now become a large and influential body, with a well-established reputation and a recognized scientific status. It becomes us all then, and especially the younger members, to keep up the good work and to do all in our power, both individually and collectively, for the well-being and prosperity of our beloved Entomological Society of Ontario. There is an unlimited field for work in this country, both in practical and scientific entomology. The life-histories of countless insects remain to be investigated, large areas of our country have never been explored, and in some orders of insects almost nothing has been done. In some department or other, each of us may do some good work even though our opportunities may be few and our time limited.

Fig. 1.

In accordance with our long established custom it now devolves upon me to bring before you some account of the chief insect attacks of the year in this province. Among those that I referred to last year, "the Eye-spotted bud-moth" (*Tmetocera ocellana*, Schiff) Fig. 1, continues to be very injurious to apple-trees in many parts of the country. Canker-worms have been very abundant and destructive in various places. (Fig. 2 represents the male and wingless female of *Anisopteryx Vernata.*) At Ottawa, on the first of June, I observed them in vast numbers upon forest trees in the neighborhood of the city, and have since been informed that they stripped them of their foliage ; they especially attacked the elm, basswood and ash, but were rarely seen upon the apple, which is the usual food of the insect. At Winnipeg also, as no steps were taken to check their ravages last year, they have continued the work of destruction upon the shade trees of the city. It is much to be deplored that the municipal authorities have not taken the trouble to protect their trees and keep the insect within due bounds.

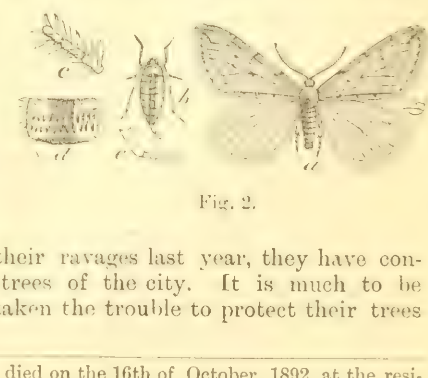


Fig. 2.

* We regret to have to record that Dr. Thomas Cowdry died on the 16th of October, 1892, at the residence of his son, Mr. E. Cowdry, Simcoe, Ont., in the 80th year of his age. Dr. Cowdry had been in poor health for some time and resided of late years in Bermuda for the sake of the genial climate. He returned to Canada in the spring and died at a good old age, much beloved and respected by all who knew him.

Cut-worms have, upon the whole, been less abundant this year. Mr. Moffat tells me that they were very injurious in gardens about London this spring, but owing to the long continued wet weather most of them had failed to mature, and consequently there were very few of the moths to be seen. Early in the season they were reported to have been very abundant in Alberta, but I have heard no particulars since. At Port Hope they were troublesome as usual when the young plants were first set out in the spring. Lately the moths of several species, especially *Hadena devastator* and *sputatrix Agrotis jaculifera ypsilon* (Fig. 3) *herilis* and *tricosa*, have been very abundant, and will probably produce a large crop of worms for next year.

Fig. 3.

The Zebra caterpillar (*Mamestra picta*, Harris) Fig. 4, has been unusally abundant this year. Its favourite food is cabbage, but I have found it injurious to salsify, beets, spinach, lettuce and other vegetables, and common also upon many weeds. The caterpillar (Fig 4, *a*) is easily recognized, being more than ordinarily handsome. When fully grown it is about two inches long, of a velvety black colour, with the head and legs red, and two bright yellow stripes along each side; between these stripes there are numerous cross bars of yellow, which are so striking that they have caused the worm to be known as the Zebra caterpillar. The moth (Fig. 4 b.) does not compare with it in beauty, being dull and inconspicuous in colour; its fore-wings are deep brown, shaded with purple and marked with paler spots in the middle; the hind wings are white, faintly edged with brown on the outer margin. It is apparently double-brooded, as we have found the caterpillars in July and August and also in October. When young the caterpillars are gregarious and feed all together on the underside of a leaf. In the case of the cabbage they thus make a conspicuous white spot, and the whole brood can easily be picked off and crushed under foot, but when they are older they scatter over the leaves and are much more difficult to deal with.

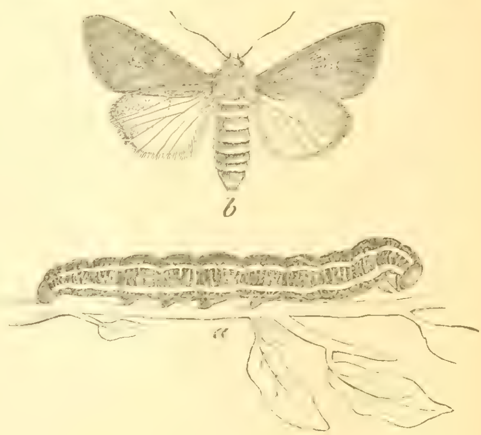


Fig. 4.

The Cabbage butterfly (*Pieris rapæ*, Linn) Fig. 5 represents the male and Fig. 6 the female, has been remarkably abundant about Port Hope this year, and very common in

Fig. 5.

Fig. 6.

the various parts of the province that I have chanced to visit. Its injuries must be very considerable, judging from what I have observed myself. The most satisfactory method

of dealing with it is the application of Persian Insect Powder (Pyrethrum.) This may be used in its pure state or mixed with four times its weight of common flour. The powder should be puffed with a small bellows into the heads of the infested cabbages as soon as the caterpillars are observed, and at different times during the season. A few applications usually suffice to destroy the insect.

Another serious enemy to the cabbage is the Root Maggot (*Anthomyia brassicæ* Bouché) which is reported as being specially injurious this year in the neighbourhood of Ottawa. In 1885 Mr. Saunders stated that the cabbage crop had been materially injured by it, and in 1890 Mr. Fletcher gave an account of it in his annual report, and mentioned that "in most parts of Canada it was the insect which gave the greatest trouble to the cabbage grower." Like most of our pests it has been imported into this country from Europe, but has long been naturalized amongst us. The perfect insect is a small two-winged fly, of a grayish colour. It lays its eggs in the spring upon the young plants, depositing them beneath the surface of the ground as far down as it can reach its ovipositor, or creep in some convenient crevice. In a few days the young maggots hatch out, feeding at first upon the outside, and subsequently as they grow larger boring into the stem. When there are many about the same plant, as is commonly the case, only a few of them penetrate the root, while the remainder live in the soil upon the exuding juices of the injured plant. The effect of the attack is the death of the plant as soon as dry weather sets in. Mr. Fletcher has found that the maggots can be destroyed by the application of a decoction of white hellebore. He used two ounces to three gallons of water, and after drawing away some of the surface soil forced the liquid about the roots of the plant with a garden syringe and then replaced the soil. The results of this treatment have, so far, been very satisfactory. Nitrate of soda as a surface dressing and watering with lime water have also been recommended as effective remedies.

The Pear-leaf blister (*Phytoptus pyri*, Sheuten) has been spreading over Ontario and the Maritime Provinces during the present season. It is a tiny mite which forms a gall on the leaf, and from the parent gall the young mites spread and form new ones, which soon give a blistered appearance to the leaf. In the autumn they remove to the leaf buds at the ends of the twigs and pass the winter beneath the leafy scales. Spraying with kerosene emulsion in the spring when the buds first open is recommended as a remedy, but nothing has as yet been found to exterminate the creature. It should be watched by our fruit growers and experiments made for its destruction.

The Fall Web-worm (*Hyphantria textor*, Harris) Fig. 7, to which I find it necessary to make an annual allusion, is this year more abundant and wide-spread than ever. Though so conspicuous and so easily dealt with, I find that few people will take the trouble to destroy it, and consequently it is rapidly becoming a most serious pest. It attacks deciduous trees of every description and also shrubs and herbaceous plants. It is especially injurious to young trees, which it soon strips of every vestige of foliage. Several young elm trees planted along the streets of Port Hope were rendered quite bare a few weeks ago by this caterpillar, whose work was done in a few days and thus escaped notice at first. These trees have put out a fresh crop of leaves, but I fear that they will be seriously exhausted of their strength, if not finally killed. Mr. Fletcher drew attention recently in the *Ottawa Field Naturalist* to the ravages of this insect, with very good results, as many people were led by his remarks to destroy the webs and their inmates wherever they found them. It is to be hoped that all the members of this Society will use their influence in the same way in any part of the country where they may be.

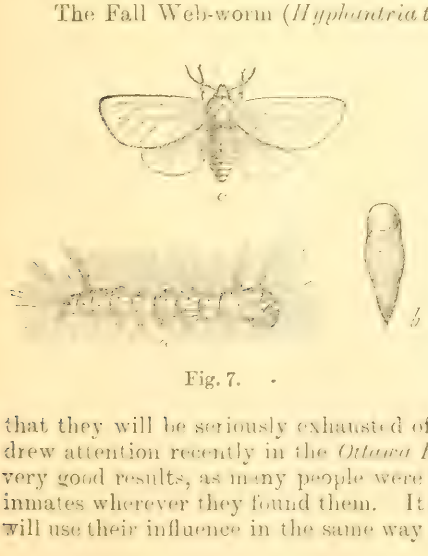


Fig. 7.

Among insects noticeable for their abundance this year, though not especially injurious, I may mention the Green grape-vine Sphinx (*Darapta myron*, Cramer)

Fig. 8.

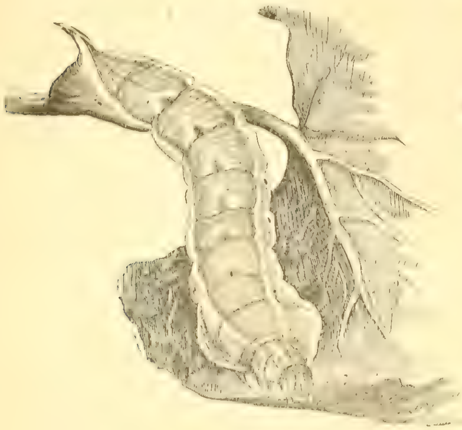


Fig. 9.

which is very numerous on the foliage of the Virginia creeper. Fig. 8 represents the moth and Fig. 9 the caterpillar. Many of the caterpillars, however, are attacked by its well known parasite, Fig. 10, and it is not likely that the insect will gain too much headway.

Fig. 10.

Another grape insect is much more injurious both to the vine and the Virginia creeper. I refer to the grape vine Flea-beetle (*Graptodera chalybea*, Illig) which is a serious pest in many parts of the country. This insect passes the winter in the perfect state, and in the spring the beetle attacks the buds of the vine as soon as they begin to swell, thus destroying the future foliage and fruit in their embryo condition. It is a small, polished steel-blue beetle, varying in colour to green and purple, about three-twentieths of an inch in length, dark green beneath, with brownish-black antennæ and feet. It is called a "flea-beetle" from its immensely developed thighs (Fig. 11) which enable it to jump long distances in the same manner as the familiar insect from which it takes its name. After a few weeks the first crop of beetles disappears, and is soon followed by colonies of little worms (Fig. 12, much magnified) dark-brown or blackish in colour, which speedily make their presence known by riddling the leaves with small holes. (Fig. 13.) These attain their full growth in July, descend to the earth to assume the pupa state, and after a week or two come out as perfect beetles. They do the greatest amount of injury in early spring, but in the summer also they are frequently very injurious by entirely stripping the vine of its foliage. I am informed by the Rev. W. J. Mackenzie that the vines in the neighbourhood of Milton have been so seriously injured by this insect, especially in the spring, that they have produced very little fruit during the last three years. The most effective remedies, so far as known, are, first, to remove and burn all fallen leaves and other rubbish about the vines in the autumn, and secondly, to syringe the canes and young foliage with a weak mixture of Paris green and water in early spring. Strong soap suds or powdered hellebore might be employed against the larvæ in the summer time, when the use of Paris green would be dangerous.

Fig. 12.

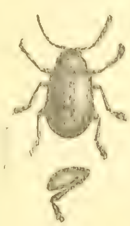


Fig. 11.

Turning from the garden to the field, I find that "Silver-top" is still very common in meadows. At the recent meeting of Economic Entomologists in Rochester, N. Y., Mr. H. Osborn, of the Iowa Experiment Stations, gave an account of his method of dealing

with this injury. It is mainly caused by small leaf-hoppers (*Jassidæ*). These are collected and destroyed by the use of a "hopper-dozer." This is a thin sheet-iron pan, about three feet in width, and of any length that may be found convenient; the back and sides of the pan are turned up about five or six inches, and the front is bent over about half an inch in order to form a smooth edge; the pan is mounted upon low wooden runners, about two inches in height, and is drawn by means of a rope attached to either end. When ready for use the pan is smeared over with coal-tar to the depth of quarter of an inch or more, and is then dragged over the infested fields. The front of the pan, as it strikes the grass, causes the hoppers to spring into the air when most of them alight on the pan and are caught in the tar. A large area can be gone over very quickly and myriads of the insects thus destroyed. A field treated in this way before the grass has

Fig. 13.

become too long, and again when it has begun to grow after cutting, will be easily kept clear of this pest. Mr. Osborn found it advantageous to keep the infested meadow closely cropped by enclosing a larger number of cows upon it than usual. This simple machine—"the hopper-dozer"—can also be used with great advantage for the destruction of grass-hoppers or locusts.

The Clover-root borer, (*Hylesinus trifolii*, Müller) is reported by Mr. Kilman to be troublesome in the neighbourhood of Ridgeway, Ont. He says that "it literally honeycombs the clover roots in all fields here during the second season of the plant's growth, and the weakened plant rarely survives the winter following. The farmers then say that their clover is 'winter-killed.'" Mr. Fletcher in his last year's report (1891) drew attention to the occurrence of this insect in Canada, and recommended as a remedy the plowing under of the clover when it is found to be infested.

The Common red-legged Grass-hopper (*Melanoplus femur-rubrum*, Burm), is very abundant just now in many parts of the Province and is doing a considerable amount of damage. It is especially injurious to oats, as it has a habit of climbing up the stalk and biting off the ear. I have been informed that a field of ten acres in the neighbourhood of Port Hope was severely damaged in this way. It would be quite worth the farmers' while to use "hopper-dozers" for these insects, as already described. By making the coating of tar about half an inch thick it would securely hold the grass-hoppers.

The Wheat-stem maggot (*Meromyza Americana*, Fitch), which is also known as "the Wheat bulb worm" when it infests the roots of the plant, has been reported as injurious in some localities. Early in the spring the pupæ of this insect are found in the roots of wheat and grasses; these are the pupæ of the last brood of the previous year and have passed the winter in this state. The flies emerge from these at the end of May and proceed to lay their eggs on the leaves of many kinds of grass, and also upon the leaves of the forming stems of wheat, which has been sown in May and is well up by the first of June. These eggs produce a small glassy green maggot which eats into the base of the top joint of wheat, barley and grasses, and causes the ear to turn prematurely white before the rest of the crop is ripe. This is the "silver-top" of wheat and barley which

is frequently to be seen about the first of July. From these maggots there comes a second brood of the flies in August which deposit their eggs on grasses and on any volunteer wheat that there may be, and finally a third brood is matured in September in time to attack the fall wheat before the cold weather sets in. The remedies which Mr. Fletcher proposes (Bulletin No. 11) are "(1) late sowing of winter wheat; (2) harrowing of stubble soon after the crop is carried, so as to start the volunteer crop quickly, this latter to be plowed in early in September; (3) the application of a special fertilizer as a top dressing when winter wheat is known to be affected, this will help the injured plants to overcome the injury."

The last insect attack to which I desire to draw your attention is, perhaps, the most formidable of all. I refer to the recent occurrence of the "Horn-fly" (*Hæmatobia serrata*, Rob.) in various parts of this Province. At the beginning of August it was first reported to Mr. Fletcher as attacking cattle at Oshawa, and soon after its appearance was announced at Toronto and London; during the last few days I have been informed of its presence at Bowmanville, Port Hope, Kingston, Ottawa and at Boucherville near Montreal. It has, no doubt, come to us from the neighbouring States where it has prevailed for some time. The insect is of European origin and has evidently been brought into the United States with imported cattle. It was first observed in New Jersey in 1887, and has now spread over the Atlantic States to Florida, as far west as Indiana and northward to Canada. The adult is a small gray fly, closely resembling the common house-fly in appearance, but a little smaller. It derives its name of Horn-fly from its singular habit of clustering, when at rest, upon the base of the horns of cows; it is by no means confined to this situation, however, but swarms upon the back between the head and foreshoulders. and on any parts which cannot be reached by the tongue or tail of the animal. When feeding it ranges over the back, flanks and legs. The injury done by this fly is by biting with its mouth-organs the skin of the animal and sucking its blood; as it occurs in great swarms, it seriously irritates the cattle and causes them, by loss of blood, to fall off in condition and diminish the yield of milk. The eggs are laid on the fresh droppings of the cattle and the insect passes its maggot stage in these; it subsequently goes down to the earth to form its pupa from which the winged fly in due time emerges. Dr. Riley and his assistants at Washington have carefully studied the life history of the insect, and state that "from ten to seventeen days, say two weeks, is about the average time from the laying of the egg to the appearance of the flies, and with four active breeding months, from May 15th to September 15th, there will be eight generations." We cannot then wonder at the sudden and enormous multiplication of the insect. The remedies that have been found most effective are the smearing of the horns and all the affected parts of the animal with any greasy substance to which a little carbolic acid has been added for the sake of its healing effect; train oil has been found especially useful as it keeps the flies away for five or six days after an application; common axle-grease and tallow have also been employed with good effect. In order to destroy the broods of the insect, the best plan is to throw a spadeful of lime over the fresh droppings, or if the weather is dry and sunny, to rake the fresh cowdung over the surface of the ground so that it may at once dry up and prevent the maggots from maturing; boys could easily perform this work, as there is always some place in the pasture field where the cattle gather during the heat of the day and where the dung can therefore be dealt with without much trouble. These methods should be especially employed in the early part of the year, wherever the insect is noticed, in order to prevent, or at any rate reduce, the subsequent broods.

Before leaving the subject of practical entomology I may allude for a moment to the splendid work that is being done all over North America by the Division of Entomology at Washington and the official entomologists at the various State experimental stations. The publication of *Insect Life* and the many bulletins that are issued both by the Federal and the State officials contain a vast fund of most useful and valuable information, the results of careful experiments in the field and the laboratory, and painstaking and conscientious studies of the life histories of insects. Similar good work is also being accomplished in this country by Mr. James Fletcher, the Dominion Entomologist at the

Central Experimental Farm at Ottawa. He and I had the pleasure recently of attending the meeting of the Association of Economic Entomologists of North America, which was held at Rochester, N. Y., on the 15th and 16th of August, and of meeting there a large number of the most eminent workers in this branch of science. In England Miss Ormerod has continued her useful work and published last winter her fifteenth "Report of Observations on Injurious Insects and Common Farm Pests," in which she gave a special account of the outbreak of caterpillars of the Diamond-back Moth (*Plutella cruciferarum*, Zeller) over large areas in Great Britain, and devoted a chapter to the use of Paris Green as an insecticide. It is satisfactory to learn that this useful agent is gradually coming into use in England and that the prejudices against its employment are being removed. In India the Trustees of the Indian Museum at Calcutta are issuing a serial publication on Economical Entomology, entitled *Indian Museum Notes*, which is now in its second volume; many of the parts are beautifully illustrated, among which we may specially mention an account of "The Wild Silk Insects of India," by Mr. Cotes, with fourteen very handsome plates.

One of the most useful publications of the year is undoubtedly a work by Dr. C. V. Riley, "Directions for Collecting and Preserving Insects," published by the Smithsonian Institution at Washington. In consists of nearly 150 pages and is illustrated by nearly as many wood cuts, most of them specially prepared for the work. The directions and instructions are most complete and will be found invaluable by beginners, and full of useful hints and ideas for those who are experienced in collecting. Every entomologist is frequently appealed to by beginners to recommend them some book which will teach them how to collect and preserve specimens and how to make a start in the study of the science; hitherto one has been at a loss for a manual which will meet such cases, but now the want is admirably filled. In time we may hope that this work will be followed by a manual of North American insects, which will perform the same service for Entomology that Dr. Gray's works have done for Botany. We are glad to learn that a step is being taken in this direction by Mr. S. H. Scudder, who is now preparing for publication a book on butterflies for boys. The author's name is a sufficient warrant that it will be all that one can desire.

Since our last annual meeting we have had to deplore the loss of two of our members. On the 18th of March Mr. F. B. Caulfield died at Montreal. Since 1887 he has been a frequent contributor to the annual reports of the Society and also wrote occasional papers for the *Canadian Entomologist*; he was also a very energetic member of the Montreal branch and did much to maintain its activity and usefulness. He was a careful and diligent collector and a keen observer. His loss is deeply felt by his associates as well as his family. We sincerely sympathize with his widow and children in their bereavement.

On the 23rd of April one of our most noted Canadian entomologists departed this life. The Abbé Léon Provancher died at Cap Rouge near Quebec, in the 72nd year of his age. His earliest publications were a treatise on Botany in 1858 and a Flora of Canada in 1862. He soon afterwards turned his attention to Entomology, and after publishing a list of the Coleoptera taken at Portneuf, he began in 1874 the publication of his Faune Entomologique du Canada, the third volume of which was not completed till 1890. For more than twenty years also he published his well known monthly magazine *Le Naturaliste Canadien*, which was only discontinued last year. He was a Fellow of the Royal Society of Canada and a member of many other scientific associations. His name will long stand out prominently in the records of science as one of the ablest and most diligent savants that our French compatriots of the Province of Quebec have produced.

I feel that I have now sufficiently trespassed upon your time and attention and beg to thank you very heartily for the kind hearing that you have given me.

Mr. FLETCHER moved a vote of thanks to the President for his interesting and valuable address, and in doing so remarked upon the prevalence of the Zebra caterpillar (*Mamestra picta*), the destruction of the Tomato sphinx and the Green sphinx of the grape-vine (*Darapsa myron*) by parasites, and the rapid spread of the Horn-fly in Ontario and Western Quebec.

The motion was seconded by the Rev. T. W. FYLES, who expressed the pleasure he had derived from listening to the address. In the course of his remarks he referred to the injuries caused by the Onion fly, and stated that it could be prevented by the use of soot, which drove away the fly, and the affected onion was then enabled to revive and complete its growth.

Mr. DENTON gave an account of some experiences in England where a fly had caused the death of a newly born calf and also attacked sheep.

Mr. FLETCHER stated that soot was not always an available remedy in this country in consequence of the prevalent use of hard coal. He found nothing better than the application of a kerosene emulsion for the destruction of this and a great variety of other insects. He proceeded to describe the ease with which an emulsion could be made and the mode of its application, as well as its effectiveness as an insecticide.

REPORT OF THE COUNCIL.

The following report was then read and adopted :

The Council of the Entomological Society of Ontario beg to present the following report of their proceedings during the past year.

The ordinary membership of the Society has been satisfactorily maintained, while the number of associate members has been considerably increased during the year. Continued interest has been taken in the various departments of the Society, and much good work has been accomplished.

The Twenty-second Annual Report on practical and general entomology was presented to the Minister of Agriculture in December last, and was printed and distributed early in February. It consisted of one hundred pages and was illustrated with eighteen wood-cuts. The report contained, among other interesting matter, a full report of the proceedings at the annual meeting of the Association of Economic Entomologists, and a valuable list of the birds of Middlesex County.

The Council are pleased to gratefully acknowledge the promptitude with which the report was printed and distributed by the Department, and also the advantage the Society has received from having the reports distributed from Toronto.

The *Canadian Entomologist* has been regularly issued at the beginning of each month, and completed its twenty-third volume in December last. It consisted of 292 pages, an increase of fifty over the usual number. Of the current volume eight numbers have so far been published, and the ninth (for September) is almost ready for distribution, the numbers have averaged over twenty-four pages each, and will make the volume at the close of the year larger than any of its predecessors. There is still a steady demand for the back volumes, which involves the occasional reprinting of a number.

Some valuable additions have been made to the Library during the past year, among which may be mentioned a set of Miss Georgiana E. Ormerod's coloured diagrams of insects injurious to vegetation, which will be found most useful for illustrating popular lectures and addresses to farmers' meetings. The Society's collections of specimens have been carefully looked after by the Curator, Mr. Moffat, many additions have been made to the Lepidoptera, and good progress has been made in the arrangement of the European Coleoptera. The Council would here express their continued satisfaction with the careful and conscientious manner in which Mr. Moffat discharges his duties towards the Society.

The Sections of the Society in the departments of Botany, Geology, Microscopy and Ornithology have been in active operation during the past year. The reports of their proceedings are submitted herewith. It is earnestly to be hoped that the interest awakened in these branches of Natural Science will not be allowed to flag, and that the number of their adherents will steadily increase.

From the Treasurer's report it will be seen that there is at present a balance on hand of $319.13, which is a larger amount than usual. The greatest care has been taken to keep the expenditure within due limits, as hitherto the amount remaining at the time of the annual meeting has not proved sufficient to carry on the work of the Society till the close of the year, during which time little or no money is received by the Society. The amount now on hand will all be required for necessary expenses before the annual subscriptions begin to be paid in January.

The Society was represented at the meeting of the Royal Society of Canada, which was held at Ottawa at the end of May, by your President, Dr. Bethune, who was subsequently elected a Fellow of the Society. During the present month of August important meetings were held at Rochester, N. Y., at which the Society was represented by the President and Mr. Fletcher. It is gratifying to record that the former was elected first Vice-President of the Association of Economic Entomologists of North America, and President of the Entomological Club of the American Association for the Advancement of Science for the ensuing year.

All which is respectfully submitted.

(Signed) Charles J. S. Bethune, President.

ELECTION OF OFFICERS.

The following were elected officers for the ensuing year:

President—W. Hague Harrington, Ottawa.

Vice-President—J. M. Denton, London.

Secretary—W. E, Saunders, London.

Treasurer— J. A. Balkwill, London.

Directors—Division 1, James Fletcher, F.L.S., F.R.S.C., Ottawa.
Division 2, Rev. Dr. Bethune, F.R.S.C., Port Hope.
Division 3, Gamble Geddes, Toronto.
Division 4, A. H. Kilman, Ridgeway.
Division 5, J. Dearness, London.

Librarian and Curator—J. Alston Moffat, London.

Editor of the "Canadian Entomologist"—Rev. C. J. S. Bethune, M.A., D.C.L., Port Hope.

Editing Committee—J. Fletcher, Ottawa; H. H. Lyman, Montreal; Rev. T. W. Fyles, South Quebec; J. H. Bowman, London.

Delegate to the Royal Society of Canada—The President.

Auditors—J. H. Bowman and W. E. Saunders, London.

The reports for the past year of the various sections of the Society were next read by their respective secretaries.

REPORT OF THE BOTANICAL SECTION OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

This Section was organized for 1892 on the 16th of April, with Mr. J. A. Balkwill as Chairman and Mr. J. Dearness as Vice-Chairman.

The meetings were held regularly up to August, with considerable interest manifested.

An outing to Komoka on the 24th of May, and one to the "Swamp of Death Oxford Co., were indulged in by some of the members.

Messrs. Dearness, Bowman, Stevenson and Althouse were very energetic in field work.

The following rare plants have been collected :

	Collector.	Locality.
Anagallis arvensis	Mr. Moffatt	Campbellville.
Poterium sanguisorba	"	"
Valerianella olitoria	Mr. Dearness	Twenty Mile Creek.
Viola rotundifolia	"	"
Corydalis glauca	Messrs. Dearness and Bowman	Pine Pond (Swamp of Death).
Dalibarda repens	" "	"
Lepidium campestre	" "	Twenty Mile Creek.
Barbarea vulgaris	" "	"
Viola carnina var rupestrhs	" "	"
Cassia Marilandica (3 ft. igh)	Mr. Dearness	Tp. of Howard.
Symphoricarpus occidentalis	"	"
Actinomeris squarrosa	"	"
Polygonatum giganteum (7 ft)	"	"
Silphium perfoliatum (7 ft.)	"	"
Euphorbia preslii	"	"
Lophanthus scrophulariaefolius	"	"
Negundo aceroides (2 ft. diameter)	"	"
Lythrum alatum	"	Walpole Island.
Polygala sanguinea	"	"
Baptisia tinctoriæ (fields)	"	"
Silphium terebinthinaceum	"	"
Tradescantia sp (?)	"	"
Galium verum	Mr. Bond	Port Stanley.
Bidens beckii	Mr. Stephenson	Port Frank.

During the year a large number of plants have been carefully mounted, the total number now in the herbarium amounts to about 500. Mr. Balkwill has done much of the mounting. The Section intends continuing the work during the coming winter.

Early in April a fine collection of plants was received from Mr. Wm. Scott, B.A., Mathematical Master of the Ottawa Normal School. The plants were in good condition and very acceptable, as they were collected in a district very different from that surrounding London.

The Section purposes continuing its explorations, and hopes to publish a list of the plants found in this district at some future time.

C. B. EDWARDS, Sec.

REPORT OF THE GEOLOGICAL SECTION.

Regular meetings have been held by the members of the Geological Section throughout the year, and they have been, on the whole, well attended. Interest in geological work has not diminished, and the meetings have often been the scene of lively discussion.

The course of study has been based on Professor Geikie's geological works, and articles in newspapers and magazines have received careful attention. The work has been agreeably helped forward by the fact that the fine collection of specimens belonging to our Chairman has always been open for the use of the Section, and they have proved invaluable for the purpose of illustrating the subjects before the section

The members have frequently been out on excursions and have secured many interesting specimens. One of the most interesting outings occurred a short time ago, when the members were accompanied by Professor Seaborne, of Hellmuth Ladies' College, who gave some interesting and valuable hints as to the best methods of working up the geology of the London district. Those of the members who spent their holidays away from home took the inevitable hammer with them, and secured many interesting examples of the life of former ages. The Chairman particularly worked up the Niagara Falls locality, and promises to furnish the Section with his observations. There are now few parts of the district immediately around London that have not been explored.

London is in an interesting district from the fact that it appears to be directly in the line of the great stream of ice which swept the northern part of the continent in the Pliocene age, and the detritus from many different geological areas are scattered plentifully around. The age to which the rocks here belong is the Devonian, but they have been covered so deeply with the glacial drift that they reach the surface in but few places. Probably the finest specimens of the trilobite, *Phacops bufo*, found in Canada have been procured here, while the race of Orthoceratidæ is well represented in this immediate vicinity. Corals are especially abundant and some fine specimens have been secured.

One of our members contemplates the arrangement of a list of Devonian fossils found around London, and hopes to be able to present it to the Society at the next annual meeting.

It is with pleasure that we learn that Mr. Johnson Pettit, to whom this Society is so much indebted, is now turning his attention to geology, and we hope to have his co-operation in the future.

S. WOOLVERTON, Chairman. J. L. GOODBURNE, Secretary.

REPORT OF THE MICROSCOPICAL SECTION.

I have much pleasure in presenting the annual report of our Section for the year ending August 31st, 1892 :

It is now two years since this Section was organized, and we can look back with pleasure upon the work of the past. Although our membership has not increased to any great extent during the last year, yet great interest is still manifested by all the members, who are rapidly gaining experience in the manipulation of the microscope and the preparation of objects.

During the past year public interest in our Section has greatly increased, as the report of our outside meetings will show. On March 3rd the Section was privileged to give a microscopical demonstration at the annual meeting of the East Middlesex Teachers

Association. The Section was again invited to the Hellmuth Ladies' College and was highly appreciated. Mr. Merchant, at the request of some of our members, very kindly granted us the use of the magnificent projecting microscope belonging to the Collegiate Institute.

The Principal gave a very interesting lecture on projection, explaining and illustrating the elementary laws of light and their application to projection.

Thirteen meetings were held last season. Total membership is 12 ; average attendance 9 ; visitors 8.

The subjects of the various evenings during the season were as follows :

Oct. 30th : Fertilization and Growth of Ferns.—Mr. Foot.

Nov. 13th : Examination of the results of an outing, all taking part.

Nov. 27th : Examination of Fungi. Family Erysiphæ.—Prof. Dearness.
Those studied were Erysipha Lamprocarpa on Hydrophyllum.
Uncinula clintonii on leaf of Basswood.
Phallactinia on leaf of Dogwood.

Dec. 11th : Examination of Fungi was continued on six other specimens.—Prof. Dearness.

Dec. 26th : How to find and classify Diatoms.—Prof. Bowman.

Jan. 15th : Life, History and Classification of Diatoms.—Prof. Bowman.

Jan. 29th : Methods of mounting Diatoms.—Prof. Bowman.

Feb. 5th : Fertilization and Growth of the Phanerogams.—Mr. Rennie.

Feb. 19th : Mounting of Seeds and Pollen.—Mr. Rennie.

Mar. 5th : Light and its application to the Microscope.—Prof. Dearness.

April 1st : Microscopical Projection.—Principal Merchant.

April 15th : Examination of Frog Spawn.—Prof. Bowman.

April 29th : Fungi.—Prof. Dearness.

All which is respectfully submitted.

William H. Foot, Secretary.

REPORT OF THE ORNITHOLOGICAL SECTION FOR THE YEAR 1892.

Mr. President and Members of the Council:

During the past year the Ornithological Section has held a number of meetings, at which many interesting facts have been noted and some new ones brought to light. During the spring months a combined record was kept of arrivals from the south, showing that 37 species were observed by the members in the first three months, 42 in April and 58 in May, against 36, 38 and 40 respectively for the year previous.

Several of the most interesting notes of the year I may perhaps be permitted to refer to briefly. First in order is the winter visitation of Crossbills. These were observed by all the members in March, April and May, the 30th of May being the last date of observation, when ten were seen. This influx included not only Red Crossbills, but also the rarer Whitewings in quantity, and one lot was seen, and two taken, of a larger form, *Loxia currirostra*, Bendirei, which is regarded as a variety intermediate between the Mexican and the Red Crossbills, and has not, we believe, been recorded for Ontario before.

Another rare species which was noted in some quantity is the Bay-breasted Warbler, which is usually scarce, but this year appeared in good numbers, being first discovered by one of our most energetic members right in the city, and subsequently found on several

morning excursions. It is probable we should be able to report the breeding of the Least Bittern in our county had it not been for the rapacious boy, who captured the pair. They were observed June 4th, and captured a few days later, and on visiting the locality, a thorough search by one of our members showed a nearly finished nest, probably of this species. The take of the season, however, was the Cape May Warbler, hitherto unknown in Middlesex County, though eagerly sought for during many years. The first specimen was discovered in the High School grounds, by the energetic member previously referred to, who studied the bird with creditable zeal for many minutes, and subsequently selected the species from a series of unnamed skins, only to be the more sorry he could not secure it when he was informed of its identity. All doubts which might have been cast on this record were cleared up by the capture of a pair, male and female, by a boy with a slingshot the next day near the same place The members of section regard this as the most important record of the year, and are proportionately proud of it. Our Plover Mills representative, with the assistance of Mr. Joseph Beck, secured a number of specimens of Lincoln's Sparrow, which had hitherto been claimed for the county on the strength of a single specimen taken years ago in the fall. Possibly it may prove, like the Fox-colored Sparrow, to be not so very rare now that we are getting acquainted with it.

Less interesting because somewhat out of the Section's range was the result of a visit of a member to Lake Wawanosh, near Sarnia, where he secured two specimens of the short billed Marsh Wren, of which probably ten or a dozen specimens were seen. They had not been previously reported in such numbers from anywhere in Ontario, although once erroneously reported near Ottawa.

In nesting records, the only one of special interest is the finding of a nest of the Carolina Rail on the outskirts of the city, with seven eggs; this being the only addition we have to make to the list of birds known to breed in Middlesex county, which was submitted with our last annual report. During the coming year we hope to open a large ledger for the birds of Middlesex in which all the notable occurrences with regard to each species shall be inscribed, thereby getting the result of our work into permanent form and making a good basis for any special investigations the Section may take up in the future.

W. E. SAUNDERS, Chairman.

MONTREAL BRANCH OF THE ENTOMOLOGICAL SOCIETY.

The following is the Nineteenth Annual Report of the Council of the Montreal Branch of the Entomological Society of Ontario:

The Council beg to submit the following report of the Branch for the year 1891-92.

During the past season nine meetings have been held, most of which were well attended, and the following papers have been read:

1. Notes on Nematus pallidiventris—Rev. T. W. Fyles.
2. Some little known Canadian Coleoptera.—J. F. Hausen.
3. Occurrence of Platynus rugiceps at Montreal.—J. F. Hausen.
4. Hepialus thule.—H. H. Lyman.
5. Notes on some species of Halisidota.—H. H. Lyman.
6. Notes on the genus Lithophane.—A. F. Winn.
7. Entomological Questions.—A. F. Winn.
8. Pamphila Manitoba and its varieties.—H. H. Lyman.
9. Danais Archippus.—A. F. Winn.
10. Notes on rearing Pyrameis Atalanta.—H. H. Lyman.
11. The genus Grapta.—H. H. Lyman.
12. Notes on Hemiptera.—J. F. Hausen.

Two new members have been added to our roll, viz., Messrs. Lachlan Gibb and J. W. Cushing, but three of our old members have resigned owing to continued absence from the city, and the death of our esteemed vice-president, Mr. F. B. Caulfield, has caused a great gap in our ranks which it will be difficult to fill. He was one of the founders of this Branch, and has taken the greatest interest in its welfare through all its vicissitudes during the past nineteen years. At our meetings he has read over forty original papers, and being an enthusiastic and pains-taking entomologist, the loss to the Branch is a very heavy one.

The Council would again urge the members to do all in their power to increase the interest in our meetings by getting as many new members as possible, and by bringing to the meetings specimens and notes on insects.

A large amount of work might easily be done during the coming summer on the neglected orders, Neuroptera, Hemiptera and Diptera, and we would suggest that each member should study at least one order besides his specialty and thus aid in increasing our knowledge of some of the many very common species of which at present we know little or nothing.

The report of the treasurer shews a balance on hand of $17.08.

Submitted on behalf of the Council,

H. H. Lyman, President.

The following officers were elected for the ensuing year : President, H. H. Lyman ; Vice-President, W. C. Adams ; Secretary-Treasurer, A. F. Winn ; Council, J. F. Hausen, Chas. Jackson.

After the reading of the foregoing reports was completed Mr. Harrington gave an interesting account of a visit which he and Mr. Fletcher had made to Sudbury this summer, and exhibited some rare and remarkable specimens that they had found in that locality.

Mr Fletcher gave an entertaining description of a trip to Nepigon, north of Lake Superior, in quest of eggs of the butterfly, *Chionobas Macounii*. No eggs of that species were obtained, but many interesting observations were made. Eggs of *Nemeophila selwynii* were secured, and the larvæ bred from them were described. *Grapta faunus* was bred from larvæ found on *Alnus viridis*, *Salix discolor* and *Betula papyrifera*, and an undescribed parasite was also reared. *Grapta progne* was also reared from larvæ on *Betula papyrifera*. *Colias interior* was mentioned, and the food plant was stated to be willow (from the observations of Mr. T. E. Bean in the Rocky Mountains). Mr. Fletcher was of the opinion that it was also *Vaccinium*. Specimens of two western species of Argynnis, *A. cipris* and *A. electa* were taken at Nepigon, and the occurrence there commented on. *Lycæna lucia* was taken and an addition made to its food plants in the flowers and seeds of *Acer spicatum*. *Carterocephalus mandan* is not uncommon at Nepigon in roadways running through low woodlands. Eggs had been secured on grasses and several larvæ were being bred. *Nisoniades icelus*, common at Nepigon, was being bred from eggs laid on the upper side of the leaves of *Salix cordata*. The larvæ were found to exhibit different temperaments, one particular specimen being described as "very bad tempered." Some beetles had been collected, and the oviposition of *Myodites zeschii* in the unopened flowers of *Solidago canadensis* was described. An interesting Mordella had been taken on a white fungus growing on an old wharf, but the species did not seem to answer to any of those in the available literature. Species of Donacia, Leptura and some Carabidæ had been collected. *Trirhabda convergens* had been found abundantly on asters and solidagos. Of Hymenoptera many interesting species had been secured, *Abia kennicottii* amongst them, and several specimens of *Trichiosoma triangulum*.

The meeting adjourned at 10 p.m.

THURSDAY MORNING, SEPTEMBER 1st.

The meeting was called to order by the President at half-past 9 o'clock.

The Rev. T. W. Fyles gave an account of a gall that he had found upon a White Aster (*Diplopappus umbellatus*). Mr. Fletcher in commenting upon it expressed the hope that Mr. Fyles would be able to work up its life history completely.

A paper by Mr. H. H. Lyman, of Montreal, on a "Trip to Mount Washington in New Hampshire" was then read by the President (see p. 32.)

Mr. Fletcher described some of the many difficulties which beset the entomologist in his efforts to rear larvæ from the egg to the imago state. An interesting discussion upon galls was then entered upon, in which most of the members present participated.

The President, Dr. Bethune, gave an account of his observations of insect life in Bermuda during the month of March last. He stated that he was most struck by the remarkable absence of insects of all descriptions. Not a single butterfly was to be seen and only one or two moths; after a diligent search under stones, etc., the only beetle that he found was the red and black Dung-beetle so common in Canada (*Aphodius fimetarius*), which he found in some cow droppings in a pasture field. Cockroaches (*Blatta Americana*), were abundant, having been brought, no doubt, in ships to the islands; a much larger species, *B. Maderensia*, was also occasionally seen. The common wasp (*Polistes Canadensis*), was found making its comb, without any protecting nest, on the leaves or branches of trees; honey bees were numerous and several species of ants, but no other Hymenoptera were observed. Mosquitoes and house-flies were common but not sufficiently numerous to be annoying, and several kinds of spiders. Great complaints were made of the difficulty of growing peaches on the islands owing to the attacks of an insect; in "Insect Life," vol. iii, p. 6, this is stated to be the maggot of a Dipterous fly (*Ceratitis capitata*, Wied.) The fruit was observed in all stages of growth at the same time, but none were in perfection except a few that had been protected with gauze netting. The fly is said to attack oranges also, but this fruit has been virtually exterminated in the Bermudas by a Scale-insect (*Chionaspis citri*), which was accidentally introduced in a shipload of oranges some years ago. Through the kindness of the Rev. W. G. Lane, Dr. Bethune had obtained three specimens of Sphinx moths, which he exhibited, viz.: (1) *Chærocampa tersa* Drury, found also in the Southern States and West Indies; this beautiful hawk-moth is distinguished by its graceful shape and long pointed body; it is of a light-brownish yellow colour, the hind wings being black with a marginal row of wedge-shaped yellow spots. The larva is said to feed on Button-weed (*Spermacoce glabra.*) (2) *Phlegethontius* (*Sphinx*) *cingulata*, Fab., a large grey hawk-moth, with the hind wings shaded with rose colour and five spots of the same colour on each side of the abdomen. It is found in the West Indies and northwards. The larva feeds on the Sweet potato and Convolvulus. (3) A large White Sphinx, probably *S. tetrio*, which was taken by Mr. Douglas Hollis in his garden at Hamilton, Bermuda. One of the greatest pests to farmers and gardeners on the Islands is the "Broken-tail Snail" (*Rumina decollata*, Linn,) which has a singular elongate spiral shell with the smaller end abruptly truncate. It seems to swarm everywhere and is very destructive to vegetation.

Mr. Moffat presented a paper on "The power of insects to resist the action of frost" (see p. 35.)

The following insects were exhibited by Mr. Fletcher:

1. *Liparocephalus brevipennis*, several specimens. This is an extremely rare Staphylinid, which had been received among other varieties from Rev. J. W. Keen, of Massett, Queen Charlotte Islands. The opinion was expressed that this and the other described species of the genus *L. orbicollis* were merely color varieties of one species. Specimens differing in color had been named under both names by Lieut. Casey, U.S.A., but he said he thought that they were probably identical, and this opinion was also concurred in by Dr. John Hamilton, to whom some of Mr. Keen's specimens had also been sent. Previous to Mr. Keen's collection these two species were only represented by the unique types.

2. *Sphærites glabratus*, *Pelates latus*, two Sylphids, also from Queen Charlotte Islands.

3. *Myodites Zeschii*, from Nepigon.

4. *Gortyna immanis*, the collar worm of the Hop, several specimens, male and female, of the moth together with pupæ and larvæ preserved in alcohol, were exhibited and a statement made of injuries done to hop gardens in Prince Edward county.

5. *Cantharis Nuttalli*, a beautiful blister-beetle from the North-West Territories, where it had been abundant and injurious in the perfect state during last summer, but probably did good service in the larval condition by feeding on locusts' eggs.

After spending some time in the examination of specimens brought by members, and contained in the Society's cabinets, and in comparing notes on various matters of entomological interest, the meeting, which was greatly enjoyed throughout by those who were present, was brought to a close.

A VISIT TO THE CANADIAN HAUNTS OF THE LATE PHILIP HENRY GOSSE.

By Rev. Thomas W. Fyles, South Quebec.

One stormy night in the winter of 1863 I was visiting at a friend's house in Laprairie when amongst the books on the table I found a copy of the *Canadian Naturalist.* I took it to my room and was fairly carried away with it I forgot the lateness of the hour; I heard not the beating of the storm upon the roof and window; I was transferred in imagination to the township of Compton, and wandered with Gosse along Bradley's Brook, and into the Brulé, and on the banks of the Coaticook. On my return to Montreal I acquired a copy of the work, which became, for a time, my constant companion.

In the *Canadian Naturalist* are to be found, as might be expected, many mistakes and imperfections; but it is, notwithstanding these, a charming work. The author seems to have thrown his life into it, and to awaken with a magic touch responsive feelings to his own in the reader's bosom; and—to speak after a heathen fashion—the book is redolent with the worship of Pan.

My interest in Gosse was increased during eleven years residence in Cowansville, in the Eastern Townships; for, during the greater portion of that time, I had for my near neighbor, and intimate acquaintance, Mr. G. E. Jaques, with whom Gosse came from Newfoundland, and with whom he lived in the summer seasons of his stay in Canada.

Of the persons who knew Gosse in his Canadian days but few survive, and the traces of his residence here are rapidly disappearing. It has been thought well, therefore, that I should place on record such reminiscences of him as I have been able to gather.

I made my first visit to Compton in 1864. The building in which Gosse taught the "Winter-school" was then much as it was in Gosse's day; and it is still substantially the same. It is a frame structure, in the ordinary village style, painted red, "picked out" with white. It stands at the outskirts of the village on the Hereford road. While I was examining it on the occasion referred to, I was joined by Mr. Logee—commonly called "Major Logee." We fell into conversation, and I asked him if he had known Gosse. "Why, yes," he said, "He boarded at my hotel. Come to the house!" The house was within sight, a few rods distant, and standing alone.* It was a commodious two-story building with a double verandah.

Mr. Logee spoke of Gosse's quiet and studious habits, and evidently entertained a pleasant remembrance of his young boarder of long ago; "but," said he, "the people here used to speak of him as *that crazy Englishman who goes about picking up bugs.*" One sentence in the *Canadian Naturalist* shows that Gosse was quite at home in the

* It still stands, but now in a street of cottages. The major has been dead for some years.—T. W. F.

major's hospitable dwelling. On page 45 we find him saying, "It is pleasant to think that we have a comfortable home and a cheerful fire to look forward to." In the long winter evenings he here recorded the observations made in the course of the day. We can fancy that we see him, in the retirement of his chamber, holding the candle at the window, and noticing the white flakes descending in the "darkness visible" (see *Can. Nat.* page 30), or musing over the "frosted flowers" on the panes (p. 29), or on the sudden formation of ice-needles, in the chilled water on the wash-stand, when agitated by the immersion of his hands (p. 351).

A few days ago I went to see my friend Quartus Bliss, Esq., of Compton, with the express purpose of gaining information concerning Gosse. We drove through the village of Compton but could then learn of only two persons who remembered him. One, a lady, was unfortunately from home; the other, when I mentioned Gosse, said, "Oh, yes! I remember him. I went to school to him. *He* couldn't teach school *any*, to suit this country." "Is that so?" I said, "but why?" "Why?" he retorted. "Well, one day when it was snowing, he took a slate and caught the snow-flakes and made drawings of them." And youthful impressions were so strong in the man, and the act had appeared so ridiculous to him in his youth that, at the remembrance of it, he laughed—and laughed—and "laughed consumedly." And the ludicrousness of this man's laughing at Gosse made me laugh, and my friend Bliss laughed for sympathy. At length, by way of creating a diversion in Gosse's favor, I said, "I think I can show you a copy of the drawing he made that day." And I took the *Canadian Naturalist* from my pocket and shewed him the cut on page 27. He seemed somewhat taken aback that anything Gosse had done should be reproduced in a book, but he soon returned to the charge: "In his garden at Smith's Mills he planted poison-poke!" (p. 233). I was, of course, duly silenced. The character of a man who could plant poison-poke in his garden was beyond redemption. I might have told of gardeners setting out plants of the pickled-cabbage order for effect: but where would have been the use?

I had given Mr. Bliss a list of the places I wished to see. As we were driving through a stretch of lowland he said, "This that we are coming to is Spafford's Bridge (p. 103). Yonder was Robinson's farm (p. 188). On the hill facing us was the Pierre Barker place, (p. 298): the house is still standing; the farm was the best in the neighbourhood in Gosse's day. To the left, here on the flat, lived Adolphus Barker a brother of Pierre, and a notorious scoundrel. The foundations of his house can still be traced."

Having ascended the hill, and passed the old Pierre Barker house, and the fine modern residence of Mr. Vernon to whom the surrounding properties now belong, we came to a turn in the road. "Here" said my friend, "was the Well's place, formerly owned by Mr. Jaques; and yonder you can trace the old main road to Sherbrooke, which has long been abolished." It was all before me: The road we were on was the "village road" (p. 2), the road that the horseman in the vignette of Gosse's title page is pursuing. Looking down from that road, immediately to the right, in the corner unmarked in Gosse's sketch, I saw the shattered foundations (overgrown with moss and lichen,) of the house in which he lived with Mr. and Mrs. Jaques. It had been a frame cottage, 30 by 24 ft. in size, and had stood five rods from the road. The barn, still standing, but much dilapidated, is eight rods from the site of the house. The foundations of Gosse's log barn can also be seen. Through "the marshy spot below the barn" (p. 116), from which he heard the "Breke-kekex koax-koax" of the frogs, the Grand Trunk Railway now runs, cutting the farm in halves. The maple-grove (p 227) has been felled, but stumps of the trees remain. No traces of the orchard are left. The whole of the farm is now in pasture.

The bridge over the Coaticook at the bottom of the farm, which he speaks of as "our bridge," has quite disappeared. It is remembered in the neighborhood as the "Wyman Bridge." Its position can be told only from the break in the old road at the river banks. On the rising ground beyond the river, and to the left of the old road, may still be seen the house in which dwelt Mr. Bill, (p. 267).

Pursuing our way we crossed Bradley's Brook (p. 297). To the left between the hills are the remains of the thicket through which Gosse forced a road to the Brulé beyond (p. 297). The hill (p. 303) which he ascended, and from which he saw Smith's mills and

Tilden's tavern, is now bare of trees, and is known as Flander's Hill. Tilden's out-buildings may still be seen from it; but the tavern itself was burned some years ago. Smith's mills are standing yet, dwarfed and hidden by more imposing structures. Hollis Smith, to whom these mills belonged, moved into Sherbrooke, and become the member of Parliament for that city. He has been dead for some years. The village of Waterville with its churches, public schools, post office, railway station, manufactories, etc., has grown up since Gosse left the country.

Only one man in Waterville, as far as I can learn, remembers Gosse. This is Captain Parker, (a descendant of the famous Admiral Parker), whose father owned the adjoining lot to that of Tilden's. The Captain when a boy, met Gosse in the Brulé net in hand. He remembers two things concerning him: (1) that he was clad in rough frieze cloth; (2) *that he wore remarkably clean linen.* "Biled shirts" were not common in that neighbourhood at that time.

In Waterville I parted with my friend Mr. Bliss.

Returning to the Gosse farm after a night spent at the village hotel, I found that there had been a hard frost in the night—one of those early frosts that Gosse complained of (p. 110). This had whitened the meadows and the foliage. The sun however rose bright and warm. On my way to the farm I came to a dip in the road (p. 180) with willows growing thick on either side. As I passed there was a constant pattering on the dead herbage beneath—the sun gaining strength was thawing the frost on the leaves, and drops fell

"like the first of a thunder shower."

A little runnel tinkled and bubbled over the stones by the road.side, hastening to join the Coaticook in the valley. Its banks were thick with moss. The slight sounds that arose seemed but to intensify the calm that boooded around. From the groves beyond the river were heard the whistle of the robin, and (softened by the distance) the cry of the blue jay. This spot in Gosse's day was prolific in insect life; as, I dare say, it is still. It was here that he captured the Baltimore Fritillary (*Melitæa Phaeton*), pictured on page 227 of his work.

When I reached the higher ground I turned; and what a glorious view was presented to me! A lovely rolling country opened towards the north, its rounded hills tufted with maple woods. Columns of white steam and dun smoke, rising amidst hills of more mountain-like formation, showed where the mining works of Capelton were located. Between the spot on which I stood and those distant hills was the rise, forming the middle distance, on which Tilden's tavern formerly stood. Around the spot, as in the days of Gosse, but more restricted, and now of second growth, is a stretch of woodland, which in the many hues of autumn, and lit by the brilliant morning sun, was very beautiful. The poplars were clad in richest chrome; the maples and beeches in various hues of ochre, sienna, Indian red, and crimson; while here and there a tamarack (lonely survivors of the *Nematus* raid) stood pale yellow amid the more richly coloured trees.

In the valley near me the placid Coaticook pursued its even way. The light green of the willows that fringed its banks formed the basis of a mass of foliage rising with the hill-side, in which was blended the brown-green of the white cedar, the sombre hues of the black spruce, and the brighter Brunswick green of the balsam. Here and there the boscage was broken by farm buildings and russet pastures.

Near the railway, not many rods from Gosse's farm and at a bend in the stream, was a small neglected burial-ground in which the white rounded head-stones rose amidst a tangle of brambles, golden-rod and everlastings. I walked over to it and found it recorded on one of the stones that Henry Learned died August 13th 1837. (Gosse may have attended his funeral). He was laid beside "Lovy" his wife,

Returning I found the point of view on which Gosse stood when he drew the sketch of his farm. The property having been added to a larger one, and seemingly used for pasturage only, is probably very much in the condition in which Gosse left it. The land is not particularly good—in the division Jaques seems to have had the better share.

Along the road-side are a few fine maples, doubtless the same represented in the view, increased in bulk by their fifty-three years subsequent growth. A few small clumps of cedar and spruce somewhat relieve the dreariness of the stretch of pasture land ; but the farm to-day is not one that would be chosen either for beauty or fertility.

Melancholy feelings come over one as he contemplates a ruined homestead, and thinks of the human interests that once centered therein. What aims and hopes actuated the builders of it ! Within its walls what scenes of homely mirth were witnessed, what hours of anxiety were spent, what plans for improvements were made, what disappointments were experienced ! Everything around had its uses and its history ; and now all is gone. The owners ! Their place knows them no more. Their belongings ! They are dispersed or have perished. Their habitation ! Its moss-grown foundations are all that remain of it.

With such feelings, tempered with the reflection that it was well for science that Gosse should have been disappointed, I looked upon the scene on which he entered full of high expectations. Here he toiled. Here he slowly learned the hard lesson that he had mistaken his vocation. Hope of acquiring an independence through his farm left him ; and he was at length glad to sell out at any sacrifice. The reasons for his failure are not hard to find from his own statements. Instead of dividing his land into meadow and pasture, and purchasing young stock to raise and sell at a profit, keeping only small portions of land successively under the plow—just so much at a time as he could manure thoroughly and work with comfort; he plowed up much unenriched soil, and laid out for himself much unprofitable labour. I have often wondered what he intended to do with his two acres of turnips (Life of P. H. Gosse, p. 92), without storage for the preservation of the produce, or stock to consume it, or any available market—for his neighbours would grow what they wanted of such like crops for themselves. The people immediately around him were generally of an unsatisfactory class, who would ridicule his mistakes, and endeavour to profit by his inexperience. They were "vulgar and sordid, sharp and mean." (Life of P. H. Gosse, p. 96). They were even worse than all this—they were criminal. A notorious band of desperadoes, counterfeiters and thieves, made the Tilden tavern their rendezvous. Dark hints of mysterious disappearances were whispered round. The dispersion of this gang was brought about in this way : Near Compton village resided a miserly old couple named Witcher, who had saved, what for those days was a large sum of money, $3,000. They had this secreted in a trunk, in an upper chamber of their house. The fact in some way became known to the gang ; and by means of a ladder access was gained to the room, and the spoil was secured. The old lady, hearing a noise which she imputed to the mice in the chamber, arose, opened the stair-case door, and thrust in the cat. She then retired contentedly to bed. The robbery caused a great commotion ; and one loose character, who left the neighbourhood during the stir, was followed up and induced to turn King's evidence. Several of the gang, having had timely warning, fled to the States ; but Adolphus B- ker was tried, convicted, and condemned to death. The sentence was commuted to imprisonment for life, and he was confined in the jail at Three Rivers. After his incarceration his wife told of his coming home one night on horseback with a dead body in front of him, which he took to the woods and buried ; but as she had become demented (which was not to be wondered at, poor thing !) no great heed was given to her statement. She soon afterwards died. Her story however was enough to cause the neighbours—the young especially—to regard the empty house with dread. One circumstance in regard to it is still narrated : I have said that the house stood back in the field. A person passing along the road one night noticed a pale unearthly light in one of the windows. He hurried away in fear. The light was seen by others on subsequent nights ; and at length a few of the boldest of the neighbours resolved to investigate it. They came to the gate leading to the house. And certainly, there in the window was the light ! They brought their courage to the sticking point and made a rush to the building ; but, as they drew near, *the light vanished !* They could hear no sound, nor could they find next day any traces of visitors, earthly or unearthly. It was not till some time afterwards that they discovered that the mysterious light was only seen when a certain room in another house in the distance was lit up—that it was, in fact, a mere reflection.

After fourteen years' imprisonment Barker was released. About the same time was liberated a French-Canadian woman who had occupied an adjoining cell. This woman Barker sought out and married, and the pair crossed over into the States. It is said that by loosening the bolts which secured the ends of a large box stove built into the partition wall they had been able to keep up an acquaintance for some time previous to their liberation. The jail arrangements of those days were of a primitive order. I have been told that, in the States. Barker resumed his nefarious practices, and eventually paid the penalty of his crimes on the scaffold.

In the Life of Gosse, page 103, we read, "During the autumn" (of 1837) "he was vexed and disturbed by having to appear in court to give evidence in a criminal case against one of his few neighbours." Could this have been the case I have been recording?

Gosse alludes, in the preface to the Canadian Naturalist, to the "stormy politics and martial alarms of the times." A few words will shew the condition of affairs in his neighborhood. It was the period of the rebellion, and as an inroad of American "sympathizers" was expected, the loyal inhabitants of the Townships felt called upon to adopt precautionary measures. At a meeting of militia officers held at Frost Village, at which Colonel Knowlton presided, it was resolved to send three of the leading men of that part of the country as a deputation to solicit supplies of arms and ammunition from the military authorities at Montreal. Accordingly Colonel Knowlton, Major Wood and Abijah Wood were sent, and their errand was completely successful. Large supplies were shipped (by way of the St. Lawrence and the Richelieu) to Philipsburg, on Missisquoi Bay. Here they were met by numerous teams driven by the yeomen farmers of the district. Good men and true from all the country round turned out to guard the valuable consignment. Night came on, and under cover of the darkness, an armed force of sympathizers from Swanton, Vermont, attacked the convoy at More's Corner. The enemy were, however, beaten off and dispersed. Volunteer companies, equipped with the arms thus acquired, were soon formed in all that section of country. Captain Wood, of Shefford, had under his command a body of cavalry numbering 85 men. Captain Savage, of the same place had 100 infantry. Captain Becket, of Sherbrooke, had a troop of horse and Captain Gilman, of Stanstead, another. In the quota of men sent from Compton Gosse's friend, Amos Merril (p. 40) was sergeant. It is rather to be wondered at that Gosse, amidst the general enthusiasm, did not take a more active interest in the military movements of the times. Perhaps it was with him as with that good bishop in the middle ages, against whom his knights and censitaires complained, that he was "a man of peace and not at all valiant." The action of the United States authorities at this crisis was prompt and judicious. Troops from the Southern States were brought up and stationed along the American side of the border, and this doubtless prevented much harm. The troops stationed at North Troy, Vermont, were brought from Florida.

Two retired English officers were sent to superintend operations and watch the line on the Canadian side. These men knew but little of the country, and amusing reminiscences of them are still told in our country houses. For instance: One of them was spending the night (a clear, cold winter night) at Hatley—the *Charleston* of Gosse (p. 95). He heard repeatedly that sound (familiar enough to Canadian ears,) which accompanies the sudden loosening of a shingle-nail by the frost. The gallant colonel arose in consternation and dressed himself in haste, convinced that because of his august presence sympathizers were firing upon the house.

One of the young men who drove a team at More's Corner, and who afterwards joined Captain Wood's troop of cavalry, was Mr. Calvin L. Hall, a son of one of the leading men of East Farnham. Mr. Hall being well mounted was chosen as a body-guard for the English officer above mentioned, and in this capacity did some hard riding. On one bleak day he, on horse-back, accompanied his superior, without stoppage, from East Hatley to Frost village, a distance of 36 miles. The Englishman, well wrapped up in buffalo robes, drove his team "at the jump," and viewed every piece of bush that he passed with suspicion. Mr. Hall is now Lt.-Colonel Hall, of the 52nd "Brome" battalion of Light Infantry.

Of Compton people contemporary with Gosse, besides Major Logee, I saw on my first visit to the village, Colonel Pomeroy, magistrate; A. V. Kendrick, merchant, and Nathan Merrill, hotel-keeper. All are now dead—as are all whom Gosse mentions in his book. Of these the last survivor was Mrs. Bill, who died at Waterville about six months ago. Ann Heap, widow of G. E. Jaques, died on December 30, 1891 in her 84th year. Her husband had died on the preceeding 12th of July, aged 84 years. The remains of this worthy couple rest in Mount Royal cemetery.

I have said that in Gosse's work there are many mistakes. One of the most remarkable of these is his supposition that the piping of the tree-frogs in early spring was produced by lizards (p. 94). He describes the frog (p. 266), but seems to have rejected the idea that this creature produced the sound, and many persons still, having read his book, have strong faith in the lizards. Good old Bishop Oxenden once spoke to me of the "whistling lizards." I begged to assure him that the "whistling" was produced by frogs—that I had kept the creatures and knew certainly that this was the case. I even showed him drawings I had made of the frog with its throat distended preparatory to the emission of the sound. But all was of no avail. *Gosse* had said that he believed the sound to be that of lizards. Gosse was once contradicted to his face by believers who did not know him personally.* That my statement should stand for a moment beside an expressed opinion of his was not to be thought of. And the good old bishop in his last work, the "History of my Life," page 142 (by a double error; by a strange transposition of sight for sound) says, "There" (i. e. in Canada) "are few reptiles, excepting lizards, which seem to take pleasure in exhibiting their antics in public."

Gosse must often have listened to the chorus from the swampy spot below his barn; the *peep-peep* of the tree-frog, the *croak* of the meadow-frog, the *tr-r-r-r-ill* of the toad and the *bomp-bomp* of the bull-frog. A lady-friend of mine compares the reptile assembly to a noisy household, in which the little children are crying to be put to bed, and the elder ones scolding, while the mother endeavours to still their clamour with a *hu-s-s-s sh*, and the father expostulates with a grumpy voice.

From the Fauna of Compton County some of its most interesting forms have vanished since 1838. The caribou *(Cervus tarandus)* and the Virginian deer *(Cervus Virginianus)* have long disappeared, and with them their natural foes the wolf *(Canis lupus)* and the puma *(Felis concolor)*. The moose *(Cervus Alces)* approaches no nearer than the swampy portions of Megantic County, and the black bear *(Ursus Americanus)* than Mount Orford and the neighboring hills of Sutton and Bolton. The cry of the lynx *(Felis Canadensis)* is seldom heard. The last pair of beavers were shot in the Brulé fifty years ago. That objectionable animal, the skunk, *(Mephitis Americana)*, so admirably delineated on page 254 of the Canadian Naturalist is, however, still quite sufficiently abundant. Gosse evidently, was well acquainted with it. By way of affording a contrast to his distressful account, I may say that a year ago a clergyman from England came to see me. He was fond of natural history and was seeking information. In the evening, happening to go to the door, I found that a skunk had crossed the lawn in front of my house. I called my friend and said, "Here is a perfume that you should know of." He sniffed and exclaimed eagerly, "What is that? What is that? *Do you know I rather like that.*" The otter (*Lutra Canadensis*) and the salmon (*Salmo salar*) are gone from the St. Francis, the Coaticook and the Massawippi. The "Salmon River" no longer bears an appropriate name, but the bald eagle (*Falco leucocephalus*) still haunts the lakes, and the snowy owl (*Strix nyctea*) and the great horned owl are still occasionally heard. The cry of the former resembles *Bomp-bomp*, that of the latter is very accurately given by Gosse as *Ho! Oho! Oho! Waugh ho!* (p. 177). The sound—so mysterious to Gosse (p. 92)—of the saw-whet owl (*Nyctale acadica*) still rises from the woods in the summer evenings. I have not seen the passenger pigeon (*Columba migratoria*) since 1864, and the scarlet tanager (*Tanagra rubra*) has become scarce.

*On one occasion, I recollect, at Livermead, we came across a party of ladies who were cackling so joyously over a rarity they had secured, that curiosity overcame our shyness, and we asked them what they had found. They named a very scarce species, and held it up for us to examine. My father, at once, civilly set them right; it was so-and-so, something much more common place. The ladies drew themselves up with dignity, and sarcastically remarked that they could only repeat that it *was* the rarity, and "Gosse is our authority."—*Life of P. H. Gosse*, p. 288.

None of the insects mentioned by Gosse, as far as I can identify them, would now be considered rarities, except the "Chequered Skipper" (p. 219), the "Pearly Eye" (p. 246), and the "Dragon Moth" (p. 248).

From the index to the *Canadian Naturalist* we find that Gosse was acquainted with 26 of our butterflies and 43 of our moths, besides a variety of beetles, bugs, flies, etc. The Lepidoptera are given below under the names used by Gosse and (as far as I have been able to identify them) the names in the "Toronto List."

Names used by Gosse.	Names according to the Toronto List.
Tiger Swallow-tail (Papilio Turnus.)	Papilio Turnus, Linn.
Black Swallow-tail (P. Asterius.)	P. Asterias, Fab.
Clouded Sulphur (Colias Philodice.)	Colias Philodice, Godt.
Grey-veined White (Pontia Oleracea.)	Pieris Oleracea, Bd. var Frigida.
Archippus Butterfly (Danais Archippus.)	Danais Archippus, Fab.
Pearl-border Fritillary (Melitœa Myrina.)	Argynnis Myrina, Cram.
Pearl-crescent Fritillary (Melitœa Tharos.)	Phyciodes Tharos, Drury.
Silver-spot Fritillary (Argynnis Aphrodite.)	Argynnis Aphrodite, Fab.
Great Spangled Fritillary (Argynnis Cybele.)	Argynnis Cybele.
Green Comma (Grapta Progne.)	Grapta Faunus, Edw.
Orange Comma (Grapta C. Album.)	Grapta Comma, Harr.
Grey Comma (Grapta C. Argenteum.)	Grapta Progne, Cram.
Violet Tip (Grapta C. Aureum.)	Grapta Interrogationis.
Camberwell Beauty (Vanessa Antiopa.)	Vanessa Antiopa, Linn.
Forked Butterfly (Vanessa Furcillata.)	Vanessa Milberti, Godt.
Compton Tortoise (Vanessa J-album.)	Grapta J-album, Bd.
Banded Purple (Limenitis Arthemis.)	Limenitis Arthemis, Drury.
Eyed Brown (Hipparchia Transmontana.)	Satyrus Nephele, Kirby.
Pearly Eye (Hipparchia Andromache.)	Debis Portlandia, Fab.
Copper (Lycœna Phleas.)	Chrysophanus Americana, D'Urban.
Spring Azure (Polyommatus Lucia.)	Lycœna Lucia, Kirby.
Black Skipper (Thymele Brizo.)	Thanaos Brizo, Bd.
Chequered Skipper (Pamphila Paniscus.)	Carterocephalus Mandan, Edw.
Yellow-spotted Skipper (Hesperia Peckius.)	Pamphila Peckius, Kirby.
Tawny-edged Skipper (Pamphila Cernes.)	Hesperia Taumas, Fab.
Twin-eyed Hawk-moth (Smerinthus Geminatus.)	Smerinthus Geminatus, Say.
Zebra Hawk-moth (Sphinx Kalmiæ.)	Sphinx Kalmiæ, A & S.
Grey Hawk-moth (Sphinx Cinerea.)	Sphinx Chersis, Hubn.
Six-spotted Blue Hawk-moth (Alypia Octomaculata.)	Alypia Langtonii, Coup.
Humble-bee Hawk-moth (Sesia Pelasgus.)	Hemaris Thysbe, Fabr.
Belted Hawk-moth (Ægeria———)	
Buff Leopard (Arctia Isabella.)	Pyrrharctia Isabella Abb. & S.
Muff (Lophocampa Tesselaris.)	Halisidota tessellata, A. & S
Panther (Spilosoma Acria.)	Leucarctia acræa, Drury.
Brindled (Biston Hirtarius.)	Eubyja cognataria, Guen.
Streaked Hooptip (Platypteryx Erosa.)	Platypteryx arcuata, Walk.
Lemon Beauty (Angerona Sospeta.)	Angerona crocaotaria, Fab.
Pea Green (Chlorissa putataria.)	
Grandee (Geometra Clemataria.)*	Procherodes clemitaria A. & S.
Rhinoceros (Herminia——)	
Belle (Spilosoma Virginica)	Spilosoma virginica, Fab.
Ruby Tiger (Pragmatobia Fuliginosa.)	Phragmatobia rubricosa, Harr.
Rose-breasted (Dryocampa Rubicunda.)	Dryocampa rubicunda, Fab.
Snowy (Spilosoma——)	Hyphantria textor, Harr.

*I have taken *P. transversata* Drury, in the Townships but not *P. clemitaria*.—T. W. F.

Names used by Gosse.	Names according to the Toronto List.
Angleshades (Phlogophora Meticulosa.)	Trigonophora periculosa, Guen.
Orange Band (Pyralis——)	Crambus Girardellus, Clem.
Veneer (Crambus.)	Crambus.
Silver-spotted Buff (Pygæra Gibbosa.)	Edema albifrons, A. & S.
Gamma (Plusia Gamma.)	Plusia precationis, Guen.
Royal Tiger (Arctia Virgo.)	Arctia virgo, Linn.
Dragon (Hepialus Argenteo-maculatus.)	Hepialus argenteo-maculatus, Harr.
Cerulean (Ctenucha Latreilliana.)	Ctenucha virginica, Charp.
Pink Arches (Thyatira Scripta)	Habrosyne scripta, Gosse.
Twin Goldspot (Plusia Iota.)	Plusia bimaculata, Steph.
Clifden Beauty (Xerene albicillata.)	Rheumaptera ruficillata, Guen.
Spotted Lemon, or Lemon Beauty.	
Drab Plume (Pterophorus——)	(Pterophorus marginidactylus.)
Vapourer (Orgyia Antiqua.)	Orgyia nova, Fitch.
Gold and Silver (Plusia Festucœ.)	Plusia Putnami, Gr.
Green Gold (Plusia Chrysitis.)	Plusia balluca, Gey.
Spangled Orange (————)	(Calopistria monetifera.)
Furbelow (Calyptra Libatrix.)	Scoliopteryx libatrix, Linn.
Griseous (Cerura Hastulifera.)	Cerura cinerea, Walk.
Apple Moth (Tethea——)	Cacœcia rosaceana, Harr.
Green Emperor (Saturnia Luna.)	Actias Luna, Linn.
Eyed Emperor (Saturnia Polyphemus.)	Telea Polyphemus, Cram.
Crimson Underwing (Catocala——)	Catocala concumbens Walk.
Winter (Cheimatobia Vulgaris.)	Operophtera borealis, Hubn.

The Entomological portions of the *Canadian Naturalist* are the weakest. If Gosse had had a little more knowledge, had taken a little more pains, and had scrupulously pared away all such provoking passages as "I shook off a black Sawfly (Tenthredo), two green Waterflies (Perla Cydippe), two Cimbices (Pentatoma——), several Chrysomelidæ with soft horn-colored elytra (Crioceris——), and another very little species of a metallic purple (Phyllodecta Kitellina)," (p. 184), which, while they have a show of knowledge, really betray the lack of it, men would have delighted to place the *Canadian Naturalist* with such classics as Kirby and Spence's Entomology, White's Natural History of Selbourne, etc. As it is, it is hardly likely that a re-print of the book will be called for; though the copies of it that remain with us are highly valued.

NOTES ON THE RARER BUTTERFLIES OF THE PROVINCE OF QUEBEC.

By Rev. Thomas W. Fyles, South Quebec.

At the annual meeting of the Entomological Society of Ontario, held in October, 1885, I read a paper on such of the Butterflies of Quebec as were then known to me. Other species have since come under my observation, and I beg to offer a few remarks upon them. The first in order is:

Colias interior, *Scudder*. I took this insect, in September, 1891, on the Heights of Levis. It seemed to be rather plentiful. I looked for it carefully in the spring of this year, but not a specimen was to be seen, nor have any since made their appearance. One would suppose that a chance irruption of the species had occurred—that prevailing winds had brought them southward. *Interior* differs from *Philodice* in that it lacks the row of reddish brown dots near the hind margins, on the underside of the wings. The black spot on the fore wings of *Philodice* is represented by a faint oval ring in *Interior*; and in the females of the latter the black border to the secondaries is wanting. I took one or two albinos of the species.

Argynnis Freya, *Thunb.* I captured, in the middle of the Gomin swamp, in September, 1887, one specimen of this rare insect. I am inclined to think that it was a straggler from some mountain swamp to the north of us. The only other specimen that I know to have been taken in Quebec Province was shewn to me, many years ago, by the late Mr. Caulfield. He received it, if I am not mistaken, from Mr. Bowles, who was then living in Quebec. My insect is in good condition, but is less bright than one of the same species from the North-west, shown to me by Mr. H. H. Lyman. I have noticed that western insects generally are of somewhat more vivid colouring than those of the same species in the east. The markings on the under-side of the hind wings of *Freya* are angulated and very intricate. The silvery embellishments are few and have a bluish tinge. One of them near the inner edge of the wing takes the form of an elongated X.

Grapta gracilis, *Gr. & Rob.* In August, 1888, I saw a butterfly escaping from its chrysalis case which was attached to a branch of a currant bush. I captured the insect which proved to be *G. gracilis.* The chrysalis was four-fifths of an inch in length, one-fourth of an inch in width of thorax, and the same in depth where the wing-cases terminated. It had numerous pointed projections. The color was light brown, mottled with dark brown over the abdomen. The butterfly in colouring is very distinct from *Progne.* On the upper side it approaches more nearly to *Faunus.* Beneath, the basal portions of wings are of a rich warm umber with some bluish-grey patches. Beyond in striking contrast, and extending through both primaries and secondaries is an irregular pearly grey band, shaded off into the dark umber of the hind margins. The arrow-heads seen so plainly near the lower portion of the hind margin in the primaries of *Progne*, are almost deleted. The silvery curve in the hind wings is very conspicuous and forms the edge of a scallop in the dark portion of the wing.

Last year, on the 12th of June, I saw *Gracilis* ovipositing on Red Currant. I found the egg. It was cone-shaped, but slightly flattened at the top ; green—of the same shade as the leaf to which it was attached,—and it had divergent longitudinal ridges of a lighter hue. I cut the twig that I might have the egg under observation ; but it did not hatch, it seemed to dry up with the leaf.

Debis Portlandia, *Fab.* In a paper entitled "A Day in the Woods," which appeared in the Society's 22nd Annual Report, I recorded my first capture on the 6th of August, 1890, of this beautiful butterfly. On July 3rd, 1891, I took a very perfect specimen of the species on Mount Royal. It fluttered down from a tree and lit in the fern a few yards from me. On July the 22nd of the present year I took a pair *in coitu*, at the spot on which I made my first capture. These also fluttered down immediately before me in the same heedless manner. *Portlandia* may be readily distinguished from our other "Browns" by the delicate purple blush on the underside. In size it comes between *Nephele* and *Canthus.*

Chionobas Jutta, *Hubner.* In 1885 I had not discovered the locality for *Jutta.* Of the means by which I found it and the successful efforts I made to rear the insect, accounts appeared in the *Canadian Entomologist*, Vol, XX., p. 131 and Vol. XXI., p. 13. Mr. Scudder in his important work on the Butterflies of the New England States and Canada mentions my success, but asks, "Does the pupa undergo its transformations in a cell as in *O. semidea*, or hanging like ordinary Nymphalids?" and he adds "Fyles does not tell us." He must have overlooked my second paper in which I said "The chrysalids were naked, unattached, and lay on the surface of the sphagnum." Under the head of Desiderata he asks, "Where in a morass mostly under water can the half-grown larva find a suitable place to hibernate, and where in the still higher waters of Spring can the caterpillar securely pupate?" These questions are easily answered as regards the Gomin Swamp. *The sphagnum rises with the water and is never submerged.* The visitor sinks in it, to the ankles in a dry season, and to the knees in a wet one ; and their are parts of it that it is well for him to avoid.

The individuals of this species that I brought to perfection passed the winter in the larval state and turned to pupæ in the Spring. Further experiments have shown that some larvæ hibernate after the second or third moult—their growth having been retarded.

This was notably the case last winter which was a remarkably open one. It may be that the larvæ have susceptibilities and powers of reservation which enable them to accommodate themselves to seasonal variations. It remains to be shewn whether the remaining stages of the backward larvæ are hastened in the Spring, that the imagos may present themselves at the usual period, or whether the larval condition of the insect is sometimes prolonged over a second season. Larvæ that I have reared to their full growth this season became sluggish in the first week of October, and by the middle of the month were quite torpid.

THECLA LÆTA, *Edw.* A specimen of this pretty little butterfly was taken in May, a few years ago, by Mr. Winn, on Belœil Mountain.

THECLA TITUS, *Fab.* On the 22nd of July last I had a stroke of good fortune. During thirty years of close observation of the insect world in this Province, I had not seen half a dozen specimens all told of *T. Titus*; but on this day, in a neglected meadow near St. David's, I came upon quite an assembly of the insects. They were fluttering about over the Hawkweed blossoms, and I captured a full series of very perfect specimens.

CHRYSOPHANUS EPIXANTHE, *Bd.* This is a swamp insect, and appears in the Gomin about the 23rd of July. I have not met with it in any other spot in Quebec Province. It appears in goodly numbers and lasts about a fortnight. It is not difficult to catch, for if the collector gets between it and the sun, the light shining upon the silvery under surface of the wings renders its flight very perceptible.

LYCÆNA COUPERI, *Grote.* On June 13th of last year I took on the Heights of Levis a lovely specimen of this charming insect. I had seen two of the kind the year before, but was unable to capture them. This year the insect has not come under my notice. On the upper side its wings are smalt blue with dark borders and white fringes. The under side, brownish grey set with white ringed, black dots, reminds one of the English *P. Acis.*

CARTEROCEPHALUS MANDAN, *Edw.* Under the name of the "Chequered Skipper" [*Pamphila Paniscus* (?)], Gosse in the *Canadian Naturalist* records the capture at Compton, P. Que., of this pretty butterfly. I have in my cabinet a specimen taken near Fort No. 2, Levis, in 1889 by Mr. Robert Maxwell, a promising young entomologist whose early death is to be lamented. On June 16th of this year Mr. Hanham took a specimen in good condition in a meadow near Bergerville. It was flitting low down amidst the stalks of herd's-grass. *Mandan* very closely resembles the European *Paniscus* in color and markings; but it is a smaller insect. Morris gives the expansion of wings of *Paniscus* at "about an inch and a quarter." My specimen of *Mandan* has an expansion of one inch only. Its contour too is different—more trim and slender.

PAMPHILA MANITOBA, *Scudder.* As this pretty skipper was taken some years ago by Mr. Couper, at Riviere-du-Loup *en bas*, only 116 miles from South Quebec and on the same side of the river, I have been expecting its advance for some time. On the 9th of September I captured my first specimen near Fort No. 2, Levis. On the 16th of the same month I took another, and on the 19th a third. The insect appears after the other skippers have vanished. I netted my specimens as they were reposing on the blossoms of Gnaphalium. A few days afterwards the insect was found in abundance by Mr. Hanham at a spot on the other side of the river, nine miles north from Quebec. As this is the only skipper we have in Quebec Province having the under sides of the hind wings *sage green with two irregular rows of white patches*, it can easily be distinguished.

PAMPHILA METACOMET, *Har.* I have two female specimens of this (with us) rare insect. They were taken on the Heights of Levis. In color they are of a sober brown and the primaries have a dark transverse streak on the upper side.

I have one specimen each of PAMPHILA EGEREMET, *Scud.*, and AMBLYSCIRTES SAMOSET, *Scud.*, taken by myself in the Eastern Townships, and one of the latter taken by Mr. R. Maxwell at Levis.

The butterflies that with us are extremely "local," being confined, as far as I know, to one or two places only, are *Chionobas Jutta*, Hub., *Thecla Augustus*, Kirby, *Thecla*

Niphon, Hub., and *Chrysophanus Epixanthe*, Bd. and Lec. I have not found *Eudamus Tityrus*, Fab., nor *Lycæna Comyntas*, Godt., east of Montreal.

The Entomologist should work his own locality thoroughly, and unexpected prizes will be very sure to reward his diligence. Two years ago a pair of *Melitæa Phaeton*, Drury, were seen flitting along the banks of a *ruisseau*, right in the town of Levis.

No doubt, as the numbers of our Entomologists increase, and new fields are brought under our observation, other haunts of our rarer species will be discovered, and names of new and advanced kinds added to our lists.

A TRIP TO MOUNT WASHINGTON.

By H. H. Lyman, Montreal.

On July 18th, 1891, I left Montreal on a trip to Mount Washington for the purpose of securing, if possible, the eggs of *Chionobas Semidea* and a goodly supply of the imagos. I expected to reach the summit that same evening, but the train was late and missed connection with the mountain train.

The next day was only partially fine, but a walk was taken along the carriage road which runs from Fabyan's to the base of the mountain, as far as the falls of the Ammonoosuc and back by the railway track, but nothing of any special interest was seen, as it was too early for *Grapta Gracilis*, and the only butterflies seen were *Argynnis Atlantis*, *Pieris Rapæ*, *Neonympha Canthus*, and a few common skippers.

All day the mountain had been covered with clouds, but as I was prepared to spend a week up there if necessary, this did not deter me ; so I went up by the train that afternoon, and on arrival at the summit received a kindly greeting from Mr. Scudder, who had been up two days and already had females caged.

I, however, was in luck, for though we had turned in with the fog as dense as ever, the ringing of a bell about four o'clock the next morning announced that a sunrise could be well observed from the platform in front of the hotel. As I had never seen a sunrise from a mountain, I got up and joined the shivering contingent, for it was horribly cold (only 49°), and with a keen wind. The day was fine, however, and promised well entomologically.

As soon as possible after breakfast we sallied forth, and as Mr. Scudder was anxious to look for *A. Montinus* we started for the head of Tuckerman's Ravine. We had not gone very far down the rock strewn slope before I had netted my first specimen of *Semidea*, and as it was a female it was promptly boxed. We entered the ravine and descended almost to the bottom of the main slope without seeing any sign of *Montinus*, and as I was confident it was not on the wing, I concluded I was wasting my time, so we parted company, Mr. Scudder going on to the bottom where the snow arch forms, while I retraced my steps to the slope above the ravine, and then struck across to Bigelow's Lawn to hunt for *Semidea*. In a few minutes I found an excellent locality, where there was a narrow sedgy slope tolerably free from rocks and interspersed with clumps of the Mountain Sandwort (*Alsine Grœnlandica*) and other flowers, and somewhat sheltered from the wind then blowing. There I took up my position and collected a good many fine specimens, besides securing half a dozen or more living females for my cage.

Here I may pause to make a short reply to Mr. Grote, and I would say that I think he is unnecessarily alarmed when he says, "What time, on 'Bigelow's Lawn,' I see the ill-advised collector, net in hand, swooping down on this devoted colony, of ancient lineage and more than Puritan affiliation, I wonder if, before it is too late, there will not be a law passed to protect the butterflies from the cupidity of their pursuers."*

* "A Colony of Butterflies," by A. R. Grote.

This species is, as Mr. Scudder says, exceedingly abundant, and many thousands must fly upon the mountain every season. Then the number of entomologists on this continent is so small, and so few are able to visit the mountain, and most of those who get there can only stay such a short time on account of the expense ; so few days are favorable for collecting, and so many are bad ; the rock strewn slopes are such difficult collecting grounds, and so few of the butterflies one starts up are secured, that there is really very little cause for alarm lest they should fail to maintain themselves in their mountain fastness. But when I attend an entomological meeting in a city of over half a million inhabitants, and find ten or a dozen men gathered around a table, while the great world outside cares for none of those things, I have more fear for the extermination of entomologists than for that of any but the rarest of the objects of their study.

When I began catching this species I treated it with my usual care for fear of damaging the specimens ; but I soon found that, in contrast to such species as *Macounii* and *Chryxus*, such care was quite unnecessary, and that it was quite possible to take them by their closed wings between the thumb and fingers and examine the genital organs before consigning them to the cyanide bottle or pill-box without causing any damage whatever. Returning to the summit with my catch, my first care was to prepare a cage, which I did by planting a small sod of the carex upon which the species feeds in an empty tomato can. I made the mistake of using a couple of wires crossing each other to support the net, the disadvantage being that any eggs laid upon the wires were practically lost, as I found it impossible to remove them without destroying them ; whereas they could have easily been removed from sticks or twigs. In the afternoon another visit was made to Bigelow's Lawn, but with less success than in the morning. Mr. Scudder remained near the summit and was so fortunate as to find a nearly mature larva in the last stage, and he also stocked two cages out of doors on growing sedge as mentioned in his paper on "Experiments with Alpine Butterflies." Psyche VI., 129.

Next day, the 21st, Mr. Scudder being very anxious to find out whether *A. Montinus* was on the wing or not, we walked down the stage road to the fifth mile post where we separated, Mr. Scudder going down to the Lodge while I struck across the slope towards Huntington's Ravine, where I had seen and taken it in 1889.

We were both unsuccessful in our search for this butterfly, but I took a specimen of *Colias Interior* and saw several other individuals which probably belonged to this species.

In the afternoon we first examined Mr. Scudder's cages in the open air, three eggs being found in the one near the stables of the stage line but none in the other where the sedge was very long and rank in growth. The whole of the twelve females were then placed in the cage near the barn and handed over to my care, and then we went on down to the Alpine Garden but met with little success, though Mr. Scudder had found *Semidea* swarming there the day before. We looked for eggs to learn, if possible, how they were laid under natural conditions but none were found.

Next morning, the 22nd, Mr. Scudder went down by the early train, carrying his small flower-pot cage with him, and I took charge of the one near the barn and added a few more females to those already in it and also to my tomato-can cage.

That morning I again collected on Bigelow's Lawn, and in the afternoon spent over an hour searching for larvæ of *Semidea* but without success. Afterwards I took a walk over to the summit of Mount Clay and saw a few *Semidea* at different points on the way. One that I started up on the shoulder between Washington and Clay flew with the wind and I made sure it would be carried down into the Great Gulf, but just after being carried over the edge it dropped in a wonderful way into a comfortable nook on the sheltered slope, which shows, I think, that they are not so helpless in a wind as is sometimes supposed.

I examined the cages several times that day but could see only a very few eggs, and began to fear that I should secure but few, but the next morning, the 23rd, I saw at a glance that a large number had been laid in the one out of doors and a number in the small cage also.

I left the large cage undisturbed as long as possible, collecting in various directions and in several orders, but at no great distance from the summit, but about noon began to dismantle the cage with the following result :

Eggs laid on green blades of sedge	2
" " " dead " " "	21
" " " stiff brown moss	45
Total	68

Those laid on the brown moss were particularly conspicuous.

At 2 p.m. I started down the mountain by train carrying the small cage with me and watched the behaviour of the imprisoned butterflies but could not see that they evinced any distress as we descended to the valley. A certain amount of restlessness was observed among some of the individuals, but nothing more than would be likely to be caused by the jarring of the mountain railway.

On arriving at the Mount Pleasant House four individuals were liberated and flew readily a distance of forty or fifty feet before alighting, which is quite as far as they often fly on the mountain.

That evening the weather turned wet and stormy, and an interesting question arises in this connection. Why were so many eggs laid that morning when so few had been laid during the two previous days? Can we suppose that the butterflies discerned the approach of bad weather and hastened to accomplish their oviposition before the weather changed?

Next day, the 24th, I went to the Profile House carrying the cage with the rest of the butterflies with me, and the following morning, the 25th, ascended Mount Lafayette taking six of them with me, as I was anxious to try the experiment of establishing the species on that mountain, the highest of the Franconia Range and rising above the Alpine limit, but I made an unfortunate mistake in putting them into too small a box, which resulted in their becoming so much enfeebled that when released they were quite unable to fly. I placed them upon a good sized patch of the same sedge that the larvæ feed upon on Mount Washington and left them to their fate ; but as a tremendous hail storm occurred in the early afternoon there could hardly be any doubt of what their fate would be.

Later in the afternoon I went to Littleton, still carrying the cage, and the next morning, Sunday, the 26th, let them go. One flew about thirty feet, one flew a few feet and one fluttered to the ground. In the afternoon three more were taken out but were too feeble to fly.

Next morning, the 27th, the cage was dismantled and the following eggs, many of which had unquestionably been laid after my descent from the mountain, were secured :

Laid loose or came off gauze	6
" on left hind leg	1
" " wire supports	18
" " gauze	6
" " brown moss and attached to it	3
" " " " but loose	20
" " dead blades of sedge	7
" " the tin can	1
Total	62

I have also a memo. of three collapsed eggs, but whether or not these were in addition to the above number I cannot now say.

I had thus from these two cages a rich harvest of no less than 130 eggs, of which only two were laid upon green blades of sedge, while the large majority were laid upon the brown moss or the wire which was about the same color as the moss. Most of the

eggs were of a creamy white color when laid, but two from my small cage were of the distinct lilac shade, which they assume before the hatching of the larvæ. About fifty eggs were mailed to Mr. W. H. Edwards, but of these he said that only about fifteen or twenty hatched, which I could not understand, as nearly all I kept disclosed the larvæ. Others were sent to Mr. Scudder, Mr. Fletcher, and the Rev. Mr. Fyles, and a good share was retained.

The first eggs in my cage were laid July 22nd, and the first larvæ hatched on August 7th, giving an egg period of sixteen days, but whether or not this stage is more extended on the mountain I am, of course, unable to say. One of my eggs failed to hatch though it retained its color and shape, so careful watch was kept on it and on August 13th a tiny parasite emerged through a small circular opening near the base. This was one of the eggs from Mr. Scudder's cage and must have been laid and parasitized either on the 22nd or morning of the 23rd, so that the cycle of life from egg to imago of this interesting little parasite must have been twenty-one or at the most twenty-two days. Mr. Scudder also had one emerge on the same day but lost it.

Being uncertain how such tiny specimens should be mounted, I did not attempt it myself, but upon a subsequent visit to Boston toward the end of the month Mr. Scudder mounted it for me in balsam. This, however, was unfortunate, as I afterwards learned from Mr. L. O. Howard, who wrote, "I very much regret that you, or rather Mr. Scudder, attempted to mount the parasite in balsam, as these hard-bodied creatures, no matter how minute, can be better studied if mounted on an ordinary paper tag. As it is, the specific characters of the insect are entirely indistinguishable. It belongs to the genus *Telonomus*, and, so far as I can see, differs from the two species which are mentioned in Scudder's 'Butterflies of the Eastern United States,' but I should not attempt to describe it."

I was travelling around a good deal from August 16th to September 3rd and carried the larvæ with me everywhere, feeding them on grass. I even had some of their regular food plant mailed to me in a tin box from Mount Washington, but as I could not see that they ate it any more freely than ordinary lawn grass I did not send for any more. Their growth was exceedingly slow, and they were very sluggish, generally remaining at full length head downwards on the edge of a blade of grass. The mortality was heavy, but I succeeded in carrying about half-a-dozen past the first moult, but all these died before the second moult. This year again (1892), I have had eggs of *Semidea* through the kindness of Mr. Scudder, who sent me about twenty eggs laid between the 11th and 14th of July. The first one hatched on July 25th and most of the others on the 26th, giving an egg period this year of fourteen days, or two days less than last year, which is probably to be accounted for by the greater heat this year. Unfortunately I was even less successful this year than last, as I did not succeed in getting any past the first moult.

ON THE POWER OF INSECTS TO RESIST THE ACTION OF FROST.

By J. Alston Moffat, London, Ontario.

If the experiments with the larva of *Laria Rossii*, as related in Mr. Lyman's paper, entitled, "Can Insects Survive Freezing," were scientifically conducted, it demonstrates that some of them can.

There is an endless diversity in the manner in which frost affects different living organisms, some can survive where the mercury freezes, whilst others succumb to the slightest touch of frost. There is a great difference in the degree of frost required to freeze different substances, and yet it is only a question of degree when all known substances may be frozen.

It is a well-known and generally conceded principle in science, that "Life in nature is adapted to its environment,"—a comprehensive expression which implies a great deal. It generally implies that long continued association has brought the life and the conditions into perfect harmony; which may imply that it has unfitted that life for a different condition. How little of the life of the temperate zones can endure the conditions of either the arctic or the tropic zones, so that what would be true of the life in one would not be true if tried in the other. In considering this subject, then, we must take into account the conditions to which the life we are dealing with has become adapted; it would never do to subject the life of temperate latitudes to the conditions of the Arctic regions, and draw our conclusions from the result.

If any form of life, from whatever cause, changes its locality, it must accommodate itself to its new conditions or perish. "There are a few forms of life that can withstand the extremes of heat and cold, but there are for every form average conditions, geologic and climatic, which are most favorable for its attaining to its fullest development." We know that some forms of life can accommodate themselves to altered conditions with comparative ease, some, with great difficulty, and some, not at all If they succeed, they may have to undergo considerable change in life, form, colour or habit, to bring them into harmony with their new environment, hence what we have to discover specially, is the powers of resistance to frost that are possessed by the insects of our latitude.

It will enable us to attain to a clearer comprehension of the subject, if we keep before the mind, the distinction that exists between warm and cold blooded animals. The one by their internal heat and external covering, can maintain an almost uniform temperature regardless of the state of the surrounding atmosphere, whilst the other has seldom any external covering, has little internal heat, and parts with that little readily whenever the external temperature goes lower.

It has been stated as a general principle in physiology, that, "wherever there is life there is heat." This may be true of active life, but there is such a thing as inactive life. For instance a tree may be frozen to the core and yet not be dead; there is no manifestation of life, but that is simply the result of unfavorable conditions. A more correct principle, and one I believe of universal application, is "that wherever there is respiration there is heat." For example, active vegetation respires; and the vegetative process is known to be productive of heat in some measure. The chemical combination by which heat is produced and maintained in warm-blooded animals, is, in great measure, well known and easily understood. Heat is the result of combustion. Combustion is obtained by a commingling of oxygen with carbon. The food taken into the stomach supplies the carbon, the air breathed into the lungs provides the oxygen, the blood flowing through the lungs is exposed over a superficial surface of from a hundred to a hundred and fifty square feet, it is thereby oxygenized, then carried in the veins to the remotest parts of the organism, and when liberated unites with the carbon of the tissues; combustion ensues, and calorification is the result. Wherever there is combustion there is waste, so waste matter is thrown off, and its place taken by fresh material. Then again, activity produces heat. Physical exertion produces rapid respiration and circulation, which produces more rapid combustion; consequently more heat. But most animals have a regulating apparatus of some kind for equalizing their temperature; when this heat is excessive, the pores open and evaporation produces refrigeration; when cold comes, these close and their heat is economized. With those of them that hibernate, the same principles are in operation. During summer time they have been laying in a supply of carbon in the shape of fat; on the approach of winter they retire to their hibernacula, settle themselves down and become somnolent. Being inactive, respiration is reduced to the minimum, consequently combustion is slow, and their heat is correspondingly reduced, but they are always warm, if alive, and they invariably leave their winter quarters greatly reduced in flesh. Now mark the contrast with cold-blooded animals, to which insects belong. They have but little heat to begin with, some requiring the most delicate instruments to detect the existence of any. Not being endowed with any regulating apparatus to save it, they part readily with what little they have as soon as the surrounding temperature goes lower, activity with them does not maintain heat, their activity depending entirely upon

the condition of the surrounding atmosphere. And when they go into hibernation, respiration is completely suspended, consequently there is no combustion and therefore no waste, and they emerge from their period of torpor, be it short or long, months or years, without the slightest perceptible loss in flesh. We are all aware of the difficulty of obtaining reliable information on scientific subjects from popular sources, even experts are often discovering that what appears to be is far from being what is. A fine illustration of this is given in connection with the controversy about the revivification of desiccated pond life.

Near the residence of a Professor Zacharias, is a granite block with a cavity holding from two to three litres of water, which evaporates in from two to six days according to the weather. There has been living therein for fifty years, by actual observation, a particular kind of Rotifer, and various Protozoans whenever the conditions were favorable. And this same fauna persisted in spite of complete desiccation, thousands of times repeated; and it was referred to as proof that the dried individuals revived. This persistence aroused the curiosity of Prof. Zacharias, and he went to work to investigate it, and he soon discovered that when the Rotifers and Protozoans were allowed to dry, they invariably died, but the eggs were preserved by encystation, and were ready to emerge when the rain came. And after long and careful investigation in other departments, he arrived at the conclusion that there was probably no such a thing as desiccated animal revivification.

The exact observations made by Dr. Hamilton, as recorded in the *Canadian Entomologist*, vol. XVII, beginning on page 35, are conclusive that certain beetles can resist the action of frost to a very great degree. Others have recorded similar observations in Lepidoptera. I have handled the pupæ of Cecropia and Polyphemus moths when exposed to 10, 15 and 20 degrees of frost and they were not solidified, the cocoon could afford them little or no protection, and the mystery is, wherein lies the power of resistance? A mystery which yet remains unsolved. I quote the following extracts—authority not stated: "Protoplasm in certain cases can endure a temperature of zero or lower; and in others can live at 90 degrees or higher temperature. This is a remarkable fact which neither physiologists nor chemists can explain. . . . The less active the life the less vulnerable it is, cold kills a great number of the lower organisms by reason of the disorganization of the tissues which takes place when congealed, and this disorganization is complete in proportion to the amount of water the tissues contain." May we not here be on the verge of an explanation of the mystery? We know that there are oils and spirits that resist a great degree of frost. May not the protoplasm of insects, larvæ and pupæ especially, be composed of fats with no water in their tissues for frost to act upon? Chemical analysis ought to be able to decide.

That a caterpillar is found in a cube of ice, is not proof that it is solidified. I have more than once seen the larva of *Arctia Isabella* embedded in ice, but as I did not investigate them as to their condition in that respect, I can add nothing; but going back upon what has been already said, it seems reasonable to suppose they were not frozen. On the approach of winter they took refuge under a board, stick or stone; when the cold increased they became torpid, snow fell; then a thaw set in, but the heat did not reach them to rouse their faculties into action; the water flowed in upon them, they could not drown, for respiration was completely suspended; frost returns, the water is congealed around them, the ice is not any colder than the air would have been, so if they could resist the action of the one, they also could that of the other. And here I would remark, that by such considerations, we get the natural explanation of how the beetles survived the winter inundation without injury, as related by Dr. Hamilton, in the article already referred to.

It is a well-known fact in medicine, that poisons act slowly, and may even be quite harmless when the temperature is low. I daresay we are all familiar with the different action of the same cyanide under different temperatures, and feeble respiration is well known to secure insects for a length of time against the poisonous fumes of cyanide. And there can be little doubt, but that by one or other of these causes, or both combined, the life of Dr. Hamilton's *Lixus Concavus* was insured against the action of alcohol. I have

taken recently transformed beetles out of decayed wood, that showed unmistakable signs of life, but were very lethargic, and they have resisted the fumes of strong cyanide for three days—no doubt the result of feeble respiration—although some claim that it is difficult to kill some insects at any time, until they have fulfilled the functions of their existence. But then again I have seen water beetles in a pond where cattle were watered, quite lively under the ice, and when the ice was cut, the pressure above produced a rush of water that brought beetles with it, and when they were tossed out on the ice they were dead instantly. That could not have been the result of contact with the ice, but from exposure to the frosty air. Dr. McCook in his "American Spiders and their Spinning Work," gives an account of some experiments made by him, with a view to discover the effects of low temperature upon them, from which he draws the following conclusions:—Vol. II, p. 135: "It would seem, therefore, first, that the hibernation of spiders, of this species at least, is not accompanied with a great degree of torpidity; second, they preserve their activity and spinning habit while exposed to cold ranging from the freezing point to zero Fahr.; third, that after long and severe exposure the recovering of complete activity, when brought into a warm temperature, is very rapid, almost immediate; and fourth, that on the return of spring, even after a prolonged and severe winter, they at once resume the habits of their kind."

"In all the above specimens the abdomens were full, indicating perfect health. Other spiders hung upon their webs with shrivelled abdomens, quite dead. . . . The living individuals were all characterized by the plump abdomen, as though there had been little or no absorption of tissues for nourishment of life. There appeared to be no growth during hibernation."

It is quite evident that a great increase to our knowledge, obtained by careful observations, is yet required before any general conclusions can be safely drawn, yet this much seems to be clearly established: That there are many insects, in some stage of their existence which can and do successfully resist the action of the severest frosts to which they are exposed in our latitude.

That these could be congealed by severer frost is quite probable; but that they would survive such freezing is yet open to doubt. That some are solidified by severe frosts and yet survive, is quite possible, but the evidence on this point is still defective.

I copy the following from the Smithsonian report for 1887, article Zoology, p. 479, and give it for what it is worth. It is entitled: "Minimum Life Temperatures." "A series of experiments upon various animals have been made by Dr. H Von Thering in extension of Professor Pouchet's researches on the resistances which animals may offer to cold. About two dozen worms, arthropods, and mollusks, were made the subject of investigation. The results have been summarized in the following terms:

(1) "Lower animals become frozen at temperatures varying greatly in the different genera and species, the resistance varies with the actual body-heat of the animal, with its size, structure, and protective covering, with the freezing point of blood, etc."

(2) "The resistance usually increases with progressive development, but sometimes the adults are more sensitive than the young."

(3) "Nothing can be directly inferred from the geographical distribution."

(4) "Perfectly frozen animals are never revivified."

Shall we add, "In his latitude?"

But there is an important economic side to this subject, as well as one of purely scientific interest. The opinion prevails extensively amongst those that are most liable to suffer from the depredations of insects, that steady severe frost in winter will greatly reduce their numbers, and thereby save them labor and loss the following summer; which is far from being the case. Those that have given the matter consideration know that such a winter is protective of insect life; it is mild, open winters that are most injurious. A large number of Lepidopterous insects pass the winter in the egg and pupal stages, and when warm weather in winter is sufficiently prolonged to start these toward

maturing, by just so much have their powers of resisting the action of frost been reduced and their liability to be injuriously affected by succeeding cold increased. Hence it is in the spring of the year that they suffer the most. A period of mild weather in early spring, followed by a protracted one of cold and wet, even when the frost is not severe, may be, and often is the cause of death to myriads of them. This is one of nature's methods of reducing their numbers. Coleopterous insects are not so liable to be injuriously affected by this cause, the reason for this is clearly and beautifully placed before us in Dr. Hamilton's paper. It is to be regretted that so little careful observation has been given to this interesting subject.

FOURTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

The fourth annual meeting was held in the University building, Rochester, N.Y., on Monday and Tuesday, August 15th and 16th. The President, Dr. J. A. Lintner, of Albany, N.Y., occupied the chair, and Prof. F. M. Webster, of Wooster, Ohio, filled the office of Secretary. The following members were also present :—C. V. Riley and L. O. Howard, Washington, D.C. ; D. S. Kellicott, Ohio ; John B. Smith, New Jersey ; E. B. Southwick, New York ; H. E. Weed, Mississippi ; M. V. Slingerland, New York ; H. Osborn, Iowa ; J. Fletcher and C. J. S. Bethune, Ontario ; C. H. Perkins, Vermont ; P. H. Rolfs, Florida ; S. A. Forbes, Illinois.

Owing to the ill-health of the President, the annual address was delivered by the Vice-President, Prof. Forbes, in which he treated especially of the work that has recently been done on the contagious diseases of insects, and the satisfactory results that have thus far been obtained. He also referred to the successful importation of several insect parasites, and drew the attention of the meeting to the desirability and importance of studying the aquatic insects of America and their relation to fish culture. This able and highly interesting address was subsequently reported upon by a special committee who warmly commended it and urged upon the attention of Economic Entomologists the recommendations in regard to "Aquatic Entomology" and its bearings upon fish culture.

Prof. Kellicott read a paper upon "Hypoderus Columbæ," a mite which is parasitic upon pigeons.

A paper by Mr. C. H. Tyler Townsend was read on "The possible and actual influence of irrigation on insect injury in New Mexico," in which he showed that in that region of the country irrigation may be made to exert a valuable influence as an adjunct to the proper use of arsenites and kerosene.

Prof. Kellicott read "Notes on Ægeriadæ of Central Ohio, No. II.," which is published in the *Canadian Entomologist*, September 1892, p. 209.

Prof. Smith said that adults of the Squash Borer (*M. ceto*) from last year's larvæ were then flying on Long Island, and that all stages of the insect might be obtained in the same field. The moths assemble in the evening on the upper sides of the leaves and are collected in great numbers by the farmers. Messrs. Forbes, Slingerland and Smith stated that in their experience the Ægerians were not attracted by electric light.

A paper on "The Bean Weevil (*Bruchus obsoletus*)" was read by Mr. M. V. Slingerland, in which he described the mode of ovipositing and gave a brief account of the life history of the insect. He stated that bi-sulphide of carbon will destroy the insect in all stages. He also read a paper on "*Drasteria erechtea*," in which he stated that in 1889 over two thousand specimens were taken by means of trap lanterns at Ithaca, N.Y. Last year he bred a number of specimens, and as a result of the study of the material thus obtained, together with about three hundred specimens from all sections of the country,

he came to the conclusion that there are two species, about equally common, included under the name *erechtea*, and that these should be called *D. eerchea*, Cram, and *D. crassiuscula*, Haworth, with *ochrea* and *distincta* as varieties of the latter. He then proceeded to describe the differences between the species, and recommended the plowing of the infested fields in order to destroy the larvæ and pupæ.

A paper by Mr. T. D. A. COCKERELL, of Kingston, Jamaica, on "*Orthezia insignis* as a garden pest," was read by the Secretary. The writer stated that the insect was first observed on a variety of exotic plants in the hot houses at Kew and elsewhere, and that he now found it injurious to several garden plants in Jamaica.

A paper by Dr. F. W. GODING on "The Food Plants of North American Membracidæ," was next read. This was followed by Prof. J. B. SMITH's paper, "Notes of the Year in New Jersey," in which he referred to the principal insect attacks that had come under his notice. In the discussion that followed, remarks were made by Mr. L. O. Howard, Prof. H. Osborn, Dr. Lintner and Prof. F. M. Webster.

Prof. WEBSTER drew attention to the occurrence of *Phytonomus punctatus* to an injurious extent in north eastern Ohio, and of *Hylastes trifolii* attacking peas in northern Ohio. He stated further that *Otiorhyncus ovatus* was found feeding upon the foliage of musk-melons.

A paper on "Two Serious Pear-tree Pests," was read by Mr. M. V. SLINGERLAND, of Cornell University.

1. The Pear-tree Psylla (*Psylla pyricola*) This insect is described as one of the most serious pests that pear growers have to fear. It had appeared in the valley of the Hudson in enormous numbers during 1891. Orchards which had given promise of 1,200 barrels of fruit having perfected less than 100 barrels. The pear-tree Psylla when mature is scarcely 3 mm. in length, shaped like a miniature cicada. The nymphs are oval and very flat and produce a great deal of honey-dew which renders the trees unsightly. There are three and perhaps four broods in the year and it is in the perfect state that the insect hibernates. As a remedy Mr. Slingerland had found that the nymphs were easily destroyed by a very weak kerosene emulsion (two per cent.) Washing the trees in winter to destroy the adults was also recommended.

2. The Pear-leaf Blister-mite (*Phytoptus pyri*) was alarmingly on the increase in the United States and Canada. It is a very small mite which hibernates beneath the bud-scales of the pear tree and comes out when the leaves expand in spring and forms blister-like galls on the foliage. Spraying the trees during the winter with kerosene emulsion had been found successful.

Prof. LINTNER stated that *P. pyri* was very abundant in eastern New York.

Prof. F. M. WEBSTER had also found it abundant in Ohio. Spraying with Bordeaux mixture had shown no effect in reducing the leaf-blisters.

Prof. J. B. SMITH had found that in orchards sprayed with the ammoniacal solution of carbonate of copper mixed with London purple, the pest was perceptibly lessened.

Mr. SOUTHWICK read a paper upon *Depressaria heracleana*, the Parsnip Web-worm, and gave an interesting account of the war waged upon it by the "Potter wasp" (*Eumenes fraterna*) and stated that he had bred from it a Hymenopterous parasite, a species of *Limneria.*

Mr. HOWARD read the following paper on "An Experiment Against Mosquitoes," which was listened to with great interest :

AN EXPERIMENT AGAINST MOSQUITOES.

By L. O. HOWARD.

One of the most reasonable of the recommendations which have been made from time to time, and which look toward the reduction of the mosquito plague during the summer months, is the application of kerosene to restricted and fishless breeding ponds. Although this remedy has often been suggested, I know of no careful records of actual experiments, and consequently deem the following account of a recent experience worthy of publication.

On the 5th of July of the present year I noticed for the first time a few mosquitoes on the porch of my cottage, in the Catskill mountains of New York. The elevation of this cottage is about 2,500 feet, and mosquitoes have hitherto been rare visitors. The month of June, however, was very wet, and as I had noticed several pools of surface water in the immediate vicinity, the presence of these mosquitoes caused me some anxiety, as I feared they would continue to breed throughout the summer and prove a serious annoyance later in the season. One of the surface pools mentioned was situated on my own grounds, and upon first noticing the mosquitoes I walked out to this spot. It was about dusk, and about a dozen or more female mosquitoes were found buzzing about the surface of the water. I immediately sprinkled four ounces of coal oil upon the surface of the pond.

Upon the following day I carefully measured the little pool and found that it contained 60 square feet. From day to day until July 15th, when I returned to Washington, observations were made. Severe rain-storms occurred on the 8th and 10th of the month, and after the first of these the pool lost the glassy irridescent surface effect given by the almost continuous but infinitesimally thin layer of kerosene. Nevertheless the insecticidal effect of the latter did not seem to diminish, although I could no longer perceive any coal oil odor. Many dead insects were found floating upon the surface of the water the next morning after the application, and these increased rapidly up to the time of my departure. The pool, which upon the evening of the 5th had been teeming with animal life, contained no living insects during the following ten days.

The actual good accomplished is shown by the following facts: All aquatic larvæ, including those of the mosquito, were killed. The kerosene, curiously enough, seemed to exercise no deterrent effect upon the adult female mosquitoes. They still continued to attempt to deposit eggs and in this attempt were destroyed. This is, in my opinion, a most important point, and one which has hardly been anticipated.

On the tenth day after the application a careful count of the dead insects floating upon the surface of the water was made over a restricted portion, and from this count the entire insect surface contents of the pool was estimated, with the following result:

Entire number of dead insects floating on the surface	7,400
Number of mosquitoes	370
Number of *Epirrita inclinata*, Walker—a small Geometrid moth	148
Number of *Heterophleps triguttata*, H.S.—another small Geometrid	42
Number of *Chrysops hilaris*, O.S.—a common gad fly of the region.....	27

These were the most conspicuous. The others were mainly minute Nematocerous Diptera, although there were a large number of small Heterocerous Lepidoptera, a few aquatic Coleoptera—the largest species being the Dytiscid *Agabus gagates*, Aubé—and also a few specimens of Cryptocerate Heteroptera.

It is difficult to say how certain of the non-aquatic species, particularly the Lepidoptera and the Chrysops, happened to be caught. They may have visited the pool to drink, or they may have been attracted to its shining surface.

The observation, it seems to me, possesses interest not only as proving definitely the efficacy of the remedy and as showing that adult mosquitoes are killed as well as their early stages, but also as affording an indication as to the amount of kerosene which will prove effective for a given surface of water, and also as affording some indication of the length of time for which a single application will be operative. It is true that upon this last point the observations were not complete, owing to my departure after ten days, but as already indicated, the influence of the kerosene outlasted all ocular or odorous evidence of its presence, and there is every reason to suppose that it would have continued for some days longer.

As a general thing, in larger ponds, which are of a more permanent character, the presence of fish is a check upon the multiplication of the mosquito. These insects breed mainly in marshy lands, where small pools, surrounded by wet soil, adjoin each other, and such spots, where accessible, can be readily and economically treated with coal oil.

The economy of the operation is shown by a simple estimate from the data which I have given, that 5 gallons of coal oil, costing say 60 cents, will treat 9,600 square feet of water surface, or, to carry the computation still further, a barrel of kerosene, costing $4.50 will treat 96,000 square feet of water surface.

With this remedy and with the drainage of swamp lands where practicable, with the introduction of fish into ponds in which they do not already occur, and with the careful watching of rain-water barrels and tanks, the mosquito plague in many localities can be readily and greatly lessened. Where mosquitoes breed, however, in the long succession of brackish marshes on the seacoast, remedial work is practically hopeless. I anticipate not the slightest practical outcome from Mr. Robert H. Lamborn's dragon fly proposition, and believe that relief in such cases will only come from extensive improvements at the public expense in the way of filling in and draining the marshes.

One word more in reference to water tanks. The use of kerosene is of course out of the question in such receptacles. A note was published in *Insect Life* (vol. iv., pp. 223-224) to the effect that the introduction of carp into water tanks in the Riviera was productive of the best results. This is a pertinent suggestion for trial in this country. The U. S. Fish Commission can doubtless furnish a limited number of carp for this purpose. All water tanks and barrels should, however, be tightly covered, and only opened occasionally for the purpose of aerating the water. When thrown open for this purpose it will not be difficult to ascertain whether larval mosquitoes (wrigglers) are present, and if so, and the tank is not too large, they can be removed by means of a fine-meshed hand net.

Interesting notes of the year were read by Prof. HOWARD EVARTS WEED.

With regard to the Horn fly Prof SMITH stated that it was not more abundant in New Jersey than the ordinary Cattle-fly (*Stomoxys calcitrans*).

Prof. KELLICOTT said that his son had found it very abundant in Central Michigan.

Mr. WEED thought that dark coloured cattle were most subject to attack. He also recorded that the insect now occurred in Louisiana.

Dr. BETHUNE stated that the Horn-fly had that month been noticed for the first time in the Province of Ontario, at Oshawa, Toronto and London, and was creating some alarm among stock owners.

Mr. P. H. ROLFS had found the Horn-fly in Florida.

Mr. OSBORN read Notes on Injurious Insects in Iowa. For want of time the discussion on this interesting paper was deferred.

Prof. C. V. RILEY read a paper on Rose saw-flies in which it was shown that there were three distinct species attacking roses.

AFTERNOON SESSION.

On reassembling the following members were elected :

Prof. P. H. Rolfs, of Florida; Mr. H. A. Gossard, of Iowa; and Mr. C. F. Baker, of Colorado.

A paper on Plant Faunæ by Mr. T. D. A. COCKERELL, of Kingston, Jamaica, was read.

Mr. JAMES FLETCHER read a paper on Injurious Insects of the Year in Canada; this gave rise to a long and interesting discussion on several points brought up in this paper, particularly with reference to the life history of *Gortyna immanis*, the different kinds of knapsack sprayers, and the most practical remedies for the Horn-fly.

Prof. WEBSTER read a paper on the aphidivorous habits of the common slug (*Limax campestris*), which was discussed by Messrs. Riley, Smith and Howard.

Dr. BETHUNE had found slugs upon trees he had sugared for moths.

The following officers were elected for the ensuing year :

President—Prof. S. A. FORBES, of Illinois.
1st Vice-President—Dr. C. J. S. BETHUNE, of Canada.
2nd VicePresident—Dr. J. B. SMITH, of New Jersey.
Secretary—Prof. H. GARMAN, of Kentucky.

And the meeting then adjourned.

ENTOMOLOGICAL CLUB OF THE A. A. A. S.

The Entomological Club of the American Association for the Advancement of Science held its annual meeting at Rochester, N.Y., August 17th to 19th, 1892, under the presidency of Mr. E. A. Schwarz, of Washington, D.C. The President's address is published in the *Canadian Entomologist* for September, 1892, pages 213-224, and the full official report in the October and November numbers; to these the reader is referred. The meeting was very interesting and successful, and was attended by over thirty persons. The Entomological Society of Ontario was represented by its President, Dr. Bethune, and Mr. James Fletcher, of Ottawa. The former was elected President of the Club for the ensuing year, when the meeting will be held at Madison, Wisconsin, in connection with the gathering of scientists at the World's Fair in Chicago.

SOME INJURIOUS MICRO-LEPIDOPTERA.

By J. Alston Moffat.

The difficulty experienced in obtaining mature examples of some of these tiny creatures is often very great. The evidence of their work may be unmistakable by the injury that is being done by their larvæ in the effort to appease the craving of their appetites, and yet it may be almost next to impossible to secure a specimen in the form that originated the mischief.

There are two good reasons to account for it, one is that many of these moths are active only at night, and secrete themselves most effectually during the day; another is the extremely brief existence of many of them in the mature state. The females generally come into the world with their eggs full size, requiring only to be fertilized before depositing. The male, as a rule, emerges first, and is awaiting the appearance of the females; when fertilization is completed he dies. The eggs are then laid by the female, which may be all done in one night's time, and when that is finished she also dies of exhaustion. Hence the necessity for rearing them in confinement, so as to obtain conclusive evidence of the particular moth that laid the eggs that produced the larva that we see is doing so much mischief. And as this requires a great deal of time, close observation and experience to accomplish successfully, we see the need there is that some should be put in a position to be able to devote their whole time to it, that thereby the community may reap the benefit of the knowledge thus obtained.

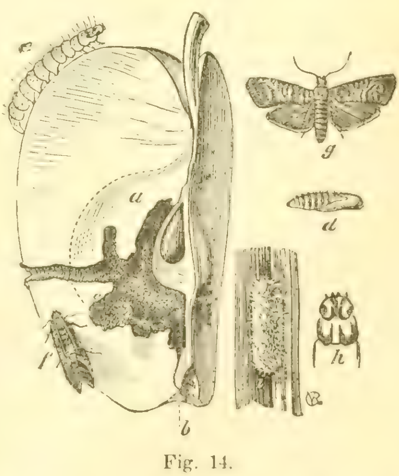


Fig. 14.

A good illustration of the truth of these remarks is got in the case of the Codling-moth, *Carpocapsa pomonella*, Linn. (Fig. 14). Almost everyone has heard of it, and knows with more or less distinctness that it is the cause of the unfortunate worminess of the apples they grow or have to use, and yet how few have ever seen the moth, or would know it if they did see it? During all the years of my collecting I have never found it in its natural locations. My first specimen was given to me by a friend who took it on his cellar window. My next were obtained by enclosing a few infected apples in a box, and not until the latter part of June, 1889, did I secure a satisfactory supply of good specimens. I was stopping in the country at a place where an old house was used as a

store room ; in the spring the apple barrels had been removed from the cellar to this store room, with the remains of the winter's fruit. The warm weather was then maturing the Pomonellas, and the south windows of the old house were literally swarming with them, large sized and in perfect condition. I took three dozen and might have taken as many hundreds.

The sequence and nomenclature of the following species is in accordance with the most recent decision of the authorities.

Pyralis, Linn. *Asopia*, Tr. *costalis*, Fab. *fimbrialis*, S. V.

Pyralis costalis, Linn. The Clover hay-moth (Fig. 15.) Expanse of wings, about three-fourths of an inch : varies considerably in size. Colors : Front wings glassy purplish brown and golden yellow ; hind wings lighter. An introduced species.


Fig. 15.

For full description of its nature and habits see the Twelfth Annual Report of the Entomological Society of Ontario. It was quite plentiful in some of the hay lofts of London last summer. The figures represent it in its various stages.

Mr. T. H. Hill, of London South, secured a very remarkable form of it last summer. The ground colour is a rich apple green, which, combined with the golden yellow of the spots, margin and fringes, makes it an exceedingly attractive object to contemplate.

Mineola, Hulst. *Phycis*, Haw. *indigenella*, Zell. *nebulo*, Walk.

Mineola indigenella, Zell. The Apple leaf crumpler (Fig. 16). Expansion of wings about seven-tenths of an inch. Colors : Pale brown and silvery white ; hind wings brownish white. Introduced. (See Fourteenth Annual Report).

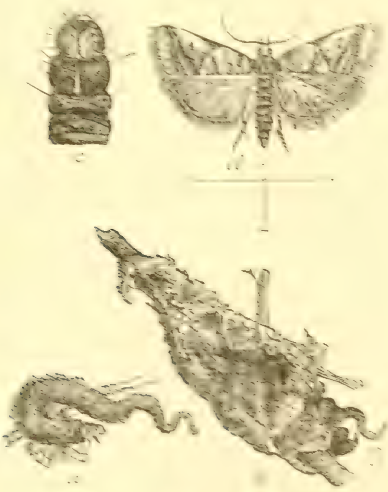


Fig. 16.


Fig. 17.

Zophodia, Hub. *Dakruma*, Grote. *grossulariæ*, Pack. *convolutella*, Hubn.

Zophodia grossulariæ, Pack. The Gooseberry fruit worm (Fig. 17). Expanse of wings, nearly an inch. Colors : Pale gray with darker streaks and bands. (See Second, Seventh and Nineteenth Annual Reports).

Canarsia, Hulet. *Pempelia*, Hub. *Hammondi*, Riley.

Canarsia Hammondi, Riley. The Apple-leaf skeletonizer (Fig. 18). Expanse of wings, not quite half an inch. The cross lines in the figure under the moth indicate the natural size. Colors: Deep purplish gray, and two silvery gray bands on the front wings, with a glossy surface.

The Larva (Figure *a*, natural size) eats the green pulp from between the veins on the upper surface of the leaf, causing it to assume a blighted appearance; *b* and *c* in the figure are portions of the larva greatly magnified.

Fig. 18.

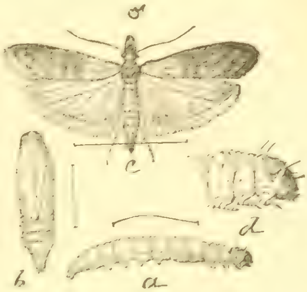


Fig. 19.

Plodia, Gn. *Ephestia*, Gn. *interpunctella*, Hub.

Plodia interpunctella, Hub. The Dried-fruit moth (Fig. 19). Expanse of wings, about half an inch. Colors: Yellowish and reddish purple. (See Twentieth Annual Report).

A few years ago I saw a half barrel of dried apples that had remained undisturbed for some time, in an upstairs chamber, and this moth had found it to be a convenient breeding place. The mature insects were in surprising numbers, resting on the inside of the barrel, and when disturbed would dart down and hide themselves amongst the pieces of apple which were completely infested with the larvæ in all stages of growth.

Cacœcia, Hub. *Loxotænia*, Steph. *rosaceana*, Harr.

Cacœcia rosaceana, Harr. The Oblique-banded leaf-roller (Fig. 20). Expanse of wings about an inch, but varies greatly. Colors: Front wings cinnamon brown, with markings of darker brown; hind wings yellow.

Fig. 20.

A very general feeder. (See First, Second, Third, Fourth and Twenty-second Annual Reports.) This moth was unusually abundant here last summer. In a bit of open woods near the city, with a thick undergrowth of oak and hazel about four feet in height, they could have been seen during the latter part of July and the first part of August, resting on the upper surface of the leaves so thickly as to arrest the attention of the most unobservant, and when a bush was jarred they would rise from it in dozens.

Cacœcia Hub. *cerasivorana* Fitch. *Cacœcia cerasivorana* Fitch. The cherry-tree leaf eater. Fig. 21.

Fig. 21.

Expanse of Wings, about three fourths of an inch.

Colors: Front wings a rich reddish yellow, with much the shade of fresh bees-wax and darker shades with cross-bands of pale leaden blue. Hind wings, pale ochre yellow.

Retinia Gn. *comstockiana* Fern. *Retinia comstockiana*, Fern. The Pitch-pine branch miner. Fig. 22.

Expanse of wings about three-fourths of an inch.

Colors: Front wings, rusty brown, with white and leaden-hued markings crossing the wings. Hind wings, greyish brown.

The figure shows the chrysalid magnified, also the larva, and its manner of working in the branches, with the effects produced in the injury and disfigurement of the tree. (See Fourteenth Annual Report.)

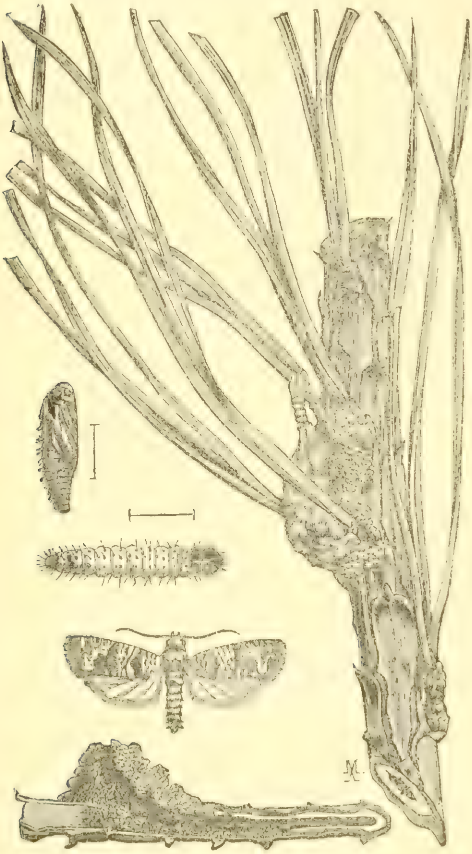


Fig 22.

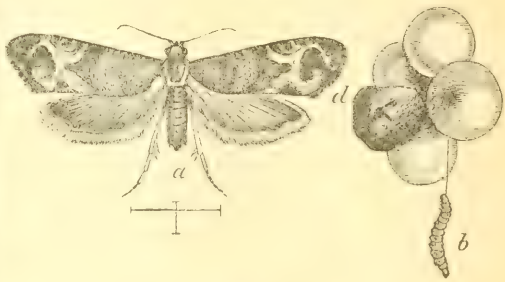


Fig. 23.

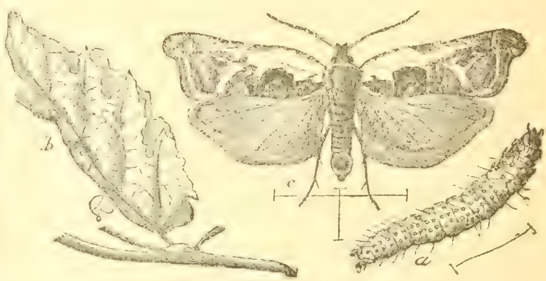


Fig. 24.

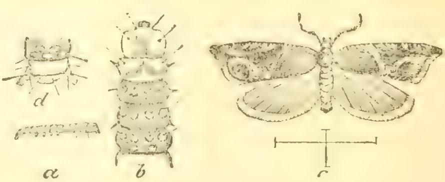


Fig. 25.

Eudemis Hub. *Penthina* Fitch. *botrana* Schiff. *vitivorana* Pack. *viteana* Clem. *Eudemis botrana*, Schiff. The Grape berry moth. Fig 23.

Expanse of wings about half an inch.

Colors: Front wings dull bluish of different shades with a metallic lustre. Hind wings, dull brown; an introduced species. (See Thirteenth and Fourteenth Annual Reports.)

Phoxopteris Tr. *nubeculana* Clem. *Phoxopteris nubeculana* Clem. The Apple-leaf sewer. Fig 24.

Expanse of wings about half an inch.

Colors: Front wings white with brown markings; hind wings light gray.

I have taken this moth only in the woods, but I do not find it so generally abundant as some of its congeners which have not yet been reported as injurious. It seems to have found the apple leaf quite to its liking, and the conditions in the orchard favorable to its increase.

Phoxopteris Tr. *Anchylopera* Wal. & Riley. *comptana* Frol. *fragariæ* W. & R. *Phoxopteris comptana* Frol. The Strawberry leaf roller. Fig. 25.

Expanse of wings about half an inch.

Colors: Front wings reddish brown, marked with black and white; hind wings dusky. An introduced species. (See Third Annual Report.)

Aspidisca Clem. *splendoriferella* Clem. *pruniella* Clem. *sacetella* Pack. *Aspidisca splendoriferella* Clem. An apple leaf miner. Fig. 26.

Colors: Front wings leaden gray, with a metallic lustre, with golden and silver spots and streaks; Hind legs gray with yellowish brown fringe.

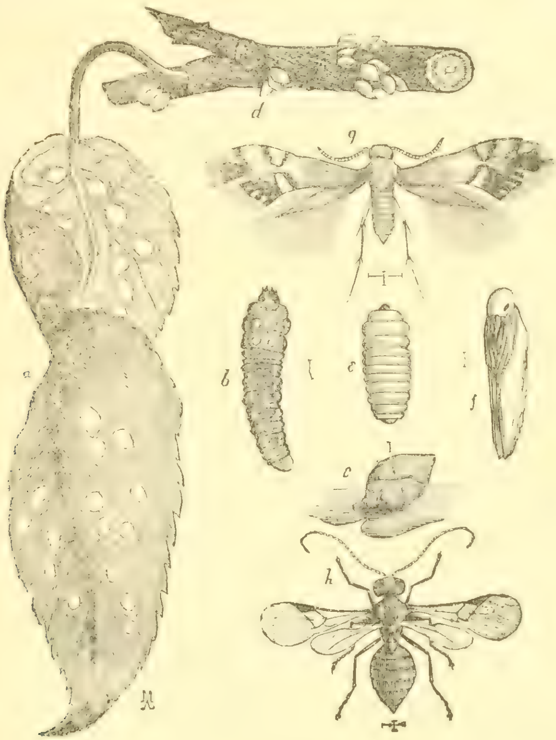


Fig. 26.

a shows the work of the minute larva in the leaf; the line at *b* gives its length; *d* illustrates the cocoons attached to the branch, and *h* is a parasite greatly enlarged. The cross lines below indicate the natural size.

Coleophora Zell. *malivorella* Riley. *multipulvella* Cham. *Coleophora malivorella* Riley. The Apple-tree case-bearer. Fig. 27.

Expanse of wings about half an inch.

Colors: Wings brown, dotted with white; thorax and abdomen white, dotted with brown. The parent moth deposits her eggs in July, the larva feeding on the underside of the leaf during August and September. On the approach of the cold weather they desert the leaves and fasten their cases to the twigs, as represented at (a) where they pass the winter. When the warm weather returns in spring they detach themselves and move about, feeding on the swelling buds, when they do the greatest injury; maturing about the beginning of July to commence another cycle.

Bucculatrix Zell. *pomifoliella* Clem. *pomonella* Pack. *Bucculatrix pomifoliella* Clem. An apple leaf feeder, as the name indicates. Fig. 28.

Expanse of wings about three-eighths of an inch.

Colors: Pale yellow and brown; *a* in the figure represents a twig with cocoons attached, *b* a cocoon detached, *c*, the moth greatly magnified.

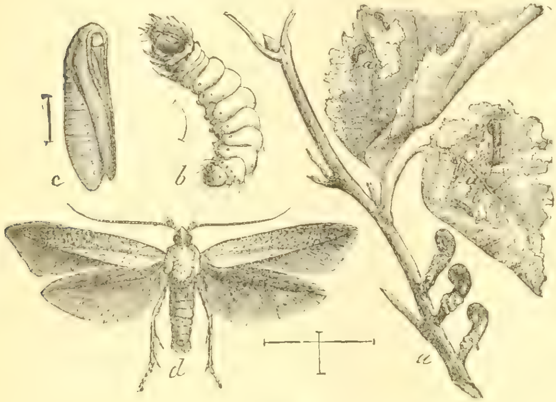


Fig. 27.

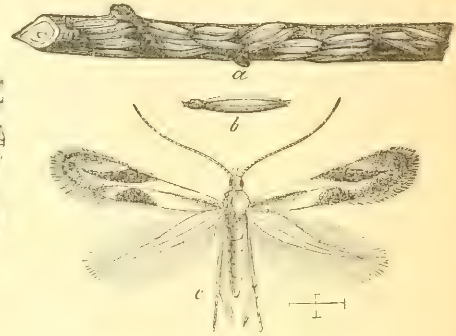


Fig. 28.

Gelechia Zell. *pinifoliella* Cham. *Gelechia pinifoliella* Cham. The Pine tree leaf-miner. Fig. 29.

Expanse of wings about three-eighths of an inch.

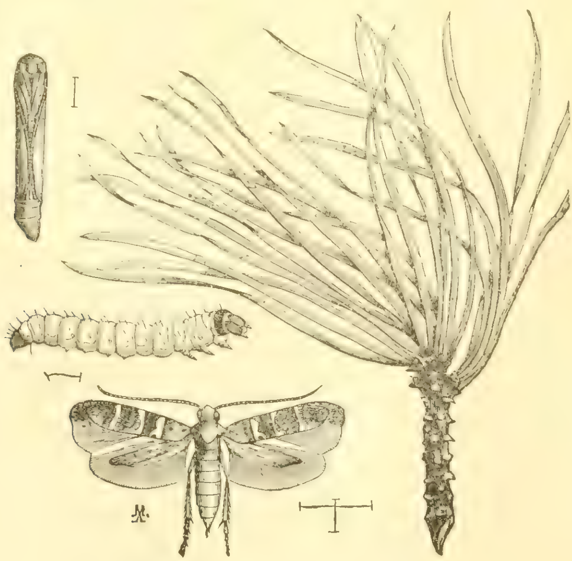


Fig. 29.

Colors: Front wings brownish yellow, dotted with fuscous, the lines crossing the wings white; hind wings pale gray.

The figure represents the insect in its various stages greatly magnified, and a terminal shoot showing the mischief done by this tiny creature. (See Fourteenth Annual Report.)

THE HORN-FLY. (*Hæmatobia serrata.* Rob.-Desv.)

By James Fletcher, F.L.S., F.R.S.C.

During the past summer a new pest of the farmer has made its appearance in Canada in the shape of a small blackish fly which appeared suddenly in enormous numbers on cattle, and was first noticed in Canada towards the end of July at Oshawa, Ont., by Mr. Elmer Lick, who sent specimens to me for identification. Almost simultaneously it was recorded all along the boundary line, from Essex County, Ontario, as far east as Boucherville, P.Q., below Montreal. The flies appeared in such enormous numbers, and their attacks upon the cattle were so severe that farmers in the districts invaded at once recognized the losses they might incur by neglecting to take steps to protect their stock. Letters of inquiry came in from all directions asking for remedies and information concerning the habits of the fly. Much alarm was felt by stock-owners, and grossly exaggerated statements received wide circulation as to the injuries which had been inflicted upon cattle of all kinds by the fly. Such complaints as the following, which are

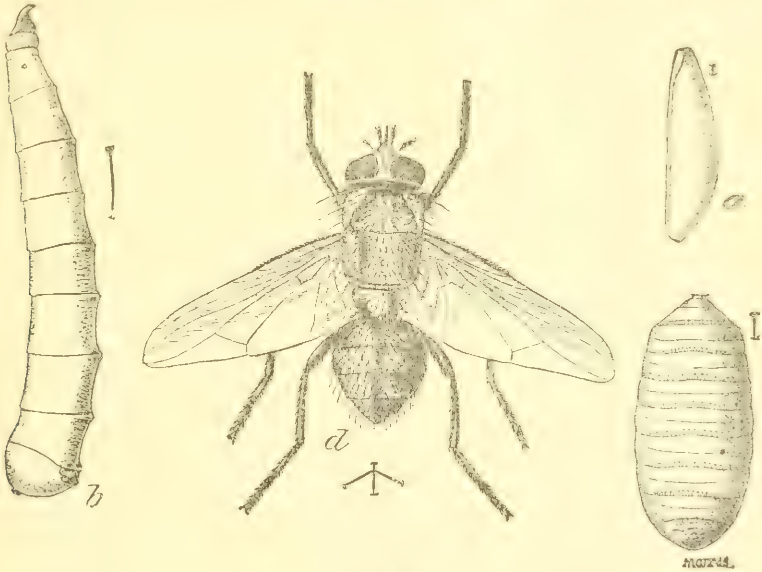


Fig. 30.

The Horn-fly. *a*, egg; *b*, maggot; *c*, puparium; *d*, adult fly in biting position—all enlarged. (Figure kindly lent by the United States Entomologist.)

actual reports I received, were by no means rare: "All the cattle in this district are being destroyed," "cows through the country are dying by hundreds," "several farmers have lost their cattle entirely," and a great many reports stated with more precision, that "neighbors" had lost from two to twelve (the favorite number being seven). Whenever these reports came in, I endeavoured to find out the name of the "neighbor," so as to trace up the true history of the case; but in no instance could I find a man who had actually lost a single animal from the attack of the flies. It was always "some other neighbour" or "I did not lose any myself, but I was told that someone else had." In fact, although this insect was undoubtedly the cause of much loss of revenue to farmers, as stated above, I have been unable to hear of even one instance where an animal was killed by its attacks. However, these exaggerated accounts of the possible loss served a very useful end, by stirring up negligent farmers to take some steps to protect their animals from the irritating attacks of their troublesome enemies. There was much cor-

respondence in the newspapers, and the irrepressible "practical man" (self-styled) came bravely to the front with useless suggestions, and, as usual, very soon showed the true nature of the occupant of the lion's skin. Inaccurate statements as to the life history of the insect gained wide credence. Of these the following is a sample: "The eggs are laid either on the horns, into which the maggots bore and then penetrate the skull, or in the holes which they eat through the hide, lay eggs therein, which hatch out in large numbers, and proceed with their boring operations until the vital portions of the cow are touched and death ensues." None of this is founded upon fact. The complete life-history has been worked out, and at once shows us the absurdity of such theories. The maggots do not feed upon flesh at all, but upon the manure of the cattle, and on this only while it is in a fresh and moist condition.

It is in the perfect state alone that the Horn-fly is troublesome to stock, and the only injuries are those which result from the irritation of its bites. These, however, are sometimes considerable, for the flies occur in such enormous numbers, and worry the cattle so incessantly, that these fall off rapidly both in flesh and yield of milk, this latter product being reduced in some cases from one third to one half. The appearance of this insect amongst our Canadian herds is, therefore, a very serious matter, and one that demands the attention of all stock-owners, so that prompt steps may be taken early in the spring to wage an incessant and systematic warfare against it upon its first appearance. There are certain simple and easily-applied remedies which may be used successfully to mitigate the attack, and if all would apply them, its numbers could be controlled with comparative ease.

For the intelligent application of suitable remedies, it is most important that the true and full life-history of the pest should be understood. It is briefly as follows:

The eggs, (Fig. 30*a*) which are about 1-20 of an inch in length, are laid singly on the freshly-dropped dung of cattle. They are brown in colour, and from this fact, not easily seen where they are laid. The young maggots hatch in less than 24 hours and at once burrow down a short distance beneath the surface of the dung, where they remain until full grown, that is, about a week, when they are about $\frac{3}{8}$ of an inch in length, white, and shaped as shown at fig. 30*b*. When full-fed they burrow a short distance into the ground and assume the pupa form (fig. 30*c*.), when they are $\frac{1}{8}$ of an inch in length. In hot weather the pupa state lasts only four or five days; but the last brood of the season, from eggs laid in September, passes the winter in that condition a short distance beneath the surface of the ground, and the flies emerge the following spring. The perfect insect (fig. 30*d*., male) is shaped very much like the common Cattle-fly (*Stomoxys calcitrans*) with which it is closely related, or the House-fly (*Musca domestica*). It is, however, much smaller, being only $\frac{1}{6}$ of an inch in length or about $\frac{1}{3}$ the size of those insects. With regard to the common Cattle-fly (*S. calcitrans*) there is an idea which is quite erroneous, but which is very prevalent among those who do not understand much about insects, that this is merely the common House-fly, which towards autumn acquires the bad habit of biting. It is much more abundant in autumn and from its annoying bites and frequent occurrence in houses is sometimes called "Biting House-fly." The true House-fly (*Musca domestica*) never bites, having only a sucking tongue with a flat disk at the tip, whilst the Cattle-flies have a sharp-pointed proboscis, which is really a case containing a slender lancet, with which they penetrate the skin of animals and suck their blood. When not in use this shining black dagger is carried projecting forward beneath the head, but when in use is turned down straight beneath the head of the fly and inserted into the tissues of the animal which is being attacked. The details of this complicated organ are fully explained and illustrated by Prof. J. B. Smith in Bulletin 62 of the New Jersey Agricultural Experimental Station.

The Horn-fly is, without any doubt, a new pest in Canada, which has come to us from the United States. It is a European insect which was first brought to the notice of the U.S. Division of Entomology in 1887, and was probably imported with cattle from Europe, where it has been known since 1830. In 1889 its complete life history was worked out by Prof. Riley and his assistants, Messrs. L. O. Howard and C. L. Marlatt. This was published in "Insect Life," vol. II., pp. 93-103, and in the annual report of the

U.S. Entomologist for 1889 and 1890. Prof. J. B. Smith, of New Jersey has published a very full account of his investigations of the same subject in New Jersey Agricultural Experimental Station Bulletin No. 62. The figures used in this article have been very kindly lent for the purpose by Prof. Riley.

The color of the Horn-fly is dark gray with yellowish sheen, and the body is covered with black bristles. The head consists almost entirely of the dark-red silvery-edged eyes. It will be at once distinguished from the common Cattle-fly by its darker colour, smaller size, greater activity and, above all, by the characteristic habit from which it takes its name, of gathering in clusters upon the horns of cattle, particularly upon the upper side. When very abundant the flies form a more or less complete ring around the horn, sometimes extending two or three inches from the base towards the tip, as shown in fig. 31. This clustering on the horns seems to be peculiar to the species, and is probably due to some special characteristic. They merely settle there, however, as a convenient resting place, from which they cannot be easily dislodged by the animal; for the same reason, they also congregate in clusters at the base of the tail and on the neck. Strange to say, while the closely allied *Stomoxys calcitrans* bites the legs of cattle very much, the Horn fly very seldom settles there, and while the *Stomoxys* bites men, dogs and horses, the present

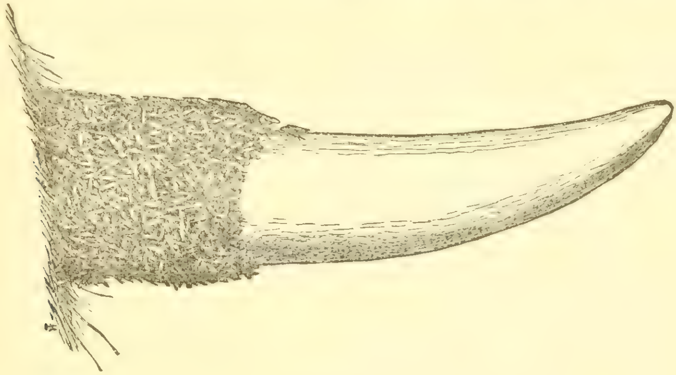


Fig. 31.

Cow-horn showing band of resting flies—reduced.

(Figure kindly lent by the United States Entomologist.)

species has not been recorded to give trouble in that way. A milkman, however, told me that on one occasion he was much bothered by Horn-flies biting his bare arms when milking, and that the bite was much more severe than that of the common Cattle-fly. It is probable that they will occasionally bite human beings, particularly when, as in the above instance, working with bare arms among cattle, and thus getting their odor on the skin.

Cattle of all breeds are subject to annoyance from this pest, but I have observed very great differences in susceptibility to injury, not only in different breeds, but also in individual animals of a given breed according to the health of the animals, temperament or the texture of their skins.

When feeding, the flies work their way down through the hairs until they can pierce the skin of their victims with their short beaks. They are exceedingly agile, and when biting keep their wings partly spread, ready to take flight at the least disturbance. A slash of the tail or a swing of the head of a bitten animal only disturbs its tormentors for a second, when they will rise in a cloud but to settle again and resume the operation of torture the next instant. The bites seem to produce great irritation, and sores are frequently formed on the necks and bodies of animals by their rubbing themselves against posts or trees or by licking bitten places, where the irritation cannot be allayed by rubbing, as inside the thighs, around and on the udder and along the milk vein.

This insect has great powers of increase. It appears early in the spring from the pupa cases, having passed the winter under ground, and also probably some specimens pass the winter in the perfect state. It breeds rapidly, only about two weeks being required in summer for each brood to mature, and there are probably six or eight broods in a season. Mr. L. O. Howard found that, at Washington, the time required from the laying of the egg to the appearance of the fly was from 10 to 17 days, and that the fly breeds from the middle of May till the middle of September.

Although only brought under my notice in July last, from enquiries made I have no doubt that this pest has been present on our Canadian stock farms throughout the summer. It was introduced into the United States only six years ago and has spread in all directions over many States of the Union and has now invaded Canada also. It has reached the most southern States and lately as far west as Texas. Curiously, however, long before it had ever reached Texas it was spoken of by farmers as "the Texas fly," and to-day in Canada more enquiries are made concerning it by this name than any other.

Remedies.

Notwithstanding the great loss which will undoubtedly result to stock-owners if they neglect to attend to this new enemy, there is no reason why it should not be kept within control by simple, cheap and well tested remedies. It is a most important matter and one that should be taken up by all Farmers' Institutes and Dairymen's Associations, so that if possible some united effort might be made to control it while the numbers are small in spring, and eventually to stamp it out. All that is necessary is for everyone to try first of all to learn what the true life history is, and in accordance with this to apply the best remedy and try to induce his neighbors to do the same.

The remedies are cheap and easily applied; but will require constant attention to make them effective. They are of two kinds, (1) *preventive*, or such as keep the flies from biting the animals; (2) *active*, or such as aim at the destruction of the insects either as maggots or flies.

1. *Preventive.* Almost any greasy substance will keep the flies away for several days. Lard, train oil, tanner's oil, fish oils, with a little sulphur, carbolic acid or oil of tar added, will keep the flies off for from five to six days. The two latter will have a healing effect on any sores which may have formed. Carbolic acid and oil of tar will mix sufficiently well with fish oils if the two substances be placed together in a bottle and well shaken. One ounce of either may be added in two quarts of oil. Axle grease and tallow have been also used to advantage. It may not be amiss to point out that no injury whatever results from the flies settling on the horns, as they only go there to rest, and cannot possibly do the horn any injury. Tar has been largely used to put on the horns of cattle, but it answers no better than the greasy substances mentioned above, and makes the animals in a horrible mess; moreover, if the flies are driven from the horns they merely fly to the animal's body, where they can do much more harm.

The remedy of this class which will eventually be found to be the best, is the mixture known as the Kerosene Emulsion, which consists simply of a mixture of soap-suds with twice the quantity of ordinary coal oil, made as follows: Boil two ounces of common soap in one quart of rain water until the soap is dissolved, then turn it into two quarts of coal oil and churn it violently with a syringe or force pump for five minutes, when it will be of a smooth, creamy nature. This gives the stock emulsion, which must be diluted before using with nine times its measure (that is 27 quarts) of water. It will mix much more easily with the water if done at once, before the stock emulsion cools. This mixture may be applied to the animals either by means of a sponge, or, what will certainly be found most convenient where there are many animals to treat, by means of a force pump and spraying nozzle. This can be done in a few minutes after milking, and one or two pints will suffice for each animal.

2. *Active.* Of applications to destroy the perfect flies, several have been recommended, as pyrethrum powder, tobacco dust, etc., but these are little if any better than the kerosene emulsion, which when sprayed over cattle killed all the flies reached and prevented others from coming for from three to seven days. But these remedies for the destruction of the perfect flies are only to be advised for use upon the first appearance of the pest in a new locality, or early in the season for the destruction of the first brood. The true way to fight this enemy is by the treatment of the cattle droppings so as to destroy the eggs and larvæ. The maggots can live in the dung only while it is in a moist condition. Any means, therefore, which will ensure its drying up will destroy them. For this purpose, lime, land plaster, and wood ashes are suggested. The last named of these will probably be found the best, not only from its strong alkaline properties, which are destructive to insect life, but also from its great value as a fertilizer, and the ease with which it can usually be obtained on every farm.

Messrs. Riley and Howard state that "throwing a spadeful of lime upon a cow-dung will destroy the larvæ living in it. If the evil should increase, it will well repay a stock raiser to start a load of lime through his fields occasionally, particularly in May or June, as every larva killed then represents the death of very many flies during July and August. We feel certain that this course will be found in many cases practical and of great avail, and will often be an advantage to the pasture besides."

I believe that Canadian wood ashes would be far superior to lime, and if neither of these were easily obtainable, a good shovelful of dry earth or road dust would soon absorb the moisture necessary for the development of the larvæ.

Of all the remedies I have tried or seen suggested, the one which commends itself to me as the most practical is by Prof. J. B. Smith, who says: "By sending a boy over the pasture every other day with a shovel to thoroughly spread out the cow-droppings, all eggs and larvæ would be destroyed." I think if this were done twice a week it would be sufficient, and the remedy would be equally effective in wet weather, when the substance would be washed away, as in dry when it is dried up.

Spread of the Horn-fly.—A correspondent in Uniontown, Pa., writes us that the Horn-fly has made its appearance in that vicinity, having first been noticed last season and having become very abundant the present summer. While spending a few weeks in Greene County, N.Y, we noticed this insect in comparative abundance, but not yet numerous enough to attract attention by the habit of congregating upon the horns. Another new locality has been given us by Mr. J. H. Woodruff, of Watertown, Conn., who has found the fly to be very abundant in his vicinity, and still another locality is Waller County, Tex. We are indebted to Mr. F. W. Thurow for specimens from this region. During the month of August complaints have also come in from quite a number of correspondents, among others from the following: Elisha Slade, Bristol County, Mass.; Miss E. J. Phillips, Cuyahoga County, Ohio; George L. Oliver, Otsego County, N. Y.; Devoe and Shumway, Montgomery County, N.Y.; T. C. Ross, Jefferson County, Iowa; B. F. Koons, Tolland County, Conn.; I. N. Rauls, Citrus County, Fla. — *Insect Life*, Sept., 1892.

CLOTHES MOTHS.

By James Fletcher, F. L. S., F. R. S. C.

In a northern climate, with such winters as we *enjoy* in Canada, furs and woollen clothing are indispensable. Only too well known to all housekeepers are the miserable little creatures which in their various forms and different species are grouped under the name of Clothes-moths. There are few indeed who have not felt the irritation of finding at some time irretrievable damage had been committed in the family supply of winter clothing, particularly of woollen underclothes, socks, mitts and furs, which it was thought had been "peppered and put safely away last spring before the moths appeared," to say nothing of the stripped patches of carpet under the piano and sofas, or even of the little

holes which had appeared suddenly in the pater-familias' dress suit, that had only been left out " for a few days after he came back from his summer holidays." All of these ills are only too well known to most people, and it is one of the grim satisfactions of careless people that at any rate the most careful get sometimes caught.

There has been very great confusion concerning the proper identification of the different caterpillars of moths which injure clothes in houses, and this confusion has been much added to by the absurd name Buffalo moth or Buffalo carpet moth, which has been given to the imported carpet beetle, *Anthrenus scrophulariæ.* In an account given in our Annual Report for 1873, there are evidently two species confounded. The whole matter was carefully revised by Prof. Fernald in 1882, and the synonymy given, together with descriptions of the three species which are found in North America, in CANADIAN ENTOMOLOGIST, Vol. XIV, p. 166. There is also an excellent illustrated article by Prof. C. V. Riley in *Insect Life*, Vol. II, p. 211. Figs. 32 and 33 used in that article have been kindly lent by Prof. Riley.

Of the three species mentioned, two only have come under my notice in Canada as household pests. Of these by far the commonest is the small creamy white or buff coloured moth, *Tineola biselliella*, Hum. This species Prof. Fernald tells us, was separated from the genus *Tinea* by Herrick Schæffer because of the absence of the maxillary palpi. The small moths (Fig. 32), less than a quarter of an inch in length, are extremely active, flying and running rapidly to hide when disturbed. The head is dull ochreous yellow ; the forewings paler and of a silvery sheen without any spots. The under wings are of a slightly different shade of color. The minute yellowish eggs are laid upon the substance which is afterwards to be the food of the young caterpillar. Immediately upon hatching, the tiny caterpillar spins a silken path upon which it travels in search of food. It never, however, forms a case, as is done by the next species to be described, until it is full fed, when it makes a cocoon generally of portions of the material upon which it has been feeding. The food of this troublesome insect is very varied, but consists mainly of fabrics composed of animal hairs ; any clothes packed away in a soiled condition are much more liable to attack than those which have been well shaken and brushed. Carpets are often attacked, particularly in darkened rooms and under heavy pieces of furniture which cannot be easily moved, and where therefore frequent sweeping is not possible. Dust in the cracks of floors and under skirt-boards provides a constant supply of food for this insect, and the active little moths penetrate drawers and boxes through very small fissures. Sable-hair paint brushes seem to be a special delicacy for these little fiends, to which, however, few things in the shape of animal hair come amiss. Some instances of their injuries which have been reported to me are the following : the felt facings of the dampers and hammers of a piano were so destroyed in a single summer as to necessitate a complete renewal ; another instance of considerable injury from this little enemy was the cutting of the woollen cord by which a large and valuable picture was suspended ; the picture fell and was not only injured itself, but did considerable damage to other objects beneath it.

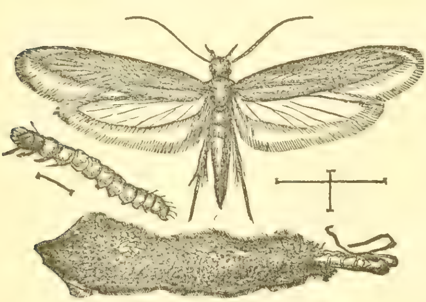


Fig. 32.—*Tineola biselliella.*

Frequently collections of insects suffer from the depredations of *Tineola biselliella*, and I have in my collection not only *Lepidoptera*, of which the wings have been destroyed, and several locusts, to which it seems very partial, but what seems to me very remarkable, a large greasy specimen of *Necrophorus orbicollis*, of which the interior has been eaten out, and the only indication of the marauder is its empty pupa case, protruding between the head and thorax of the beetle.

The white grub-like caterpillar of this species never forms a true case as does that of another species, *Tinea tapetzella*, which makes for itself a silken gallery mixed with

fragments of the material it is destroying; but it spins a more or less complete silken tube through the hair when attacking fur.

Although the moths appear throughout the summer, it is stated that there is in the north only one brood in the year, but I think this can hardly be the case, and, although I have this season failed in rearing the young caterpillar from the egg, a brood hatched early in June contained some specimens which were 4.50 mm. by the middle of August, when the whole of them died without any apparent cause; and the perfect insects were to be found flying from the month of May until September the 28th. The caterpillar attains full growth in autumn, when it builds for itself a close cocoon in which it remains unchanged until spring For this purpose it occasionally takes other materials than those it has been feeding on. I have one cocoon composed of asbestos fibres which were in a drawer with some paint brushes that had been destroyed, but the asbestos fibre alone had been used in the formation of the cocoon. Another cocoon is composed of fibres of cotton wadding and the caterpillar had apparently subsisted almost entirely upon the gummy coating with which the surface of the wadding had been dressed.

Tinea pellionella is thought by Prof. Riley to be the commoner species in northern regions, but this has not been my experience. In fact, it has only been sent to me from Nova Scotia, New Brunswick, and on one occasion from Toronto. In this latter case, it had certainly been recently imported from England. In Prof. Riley's interesting account in *Insect Life*, its habits are thus briefly described: "The small light brown moths distinguished, as shown at Fig. 33 by the darker spots at intervals on the wings, begin to appear in May, and are frequently seen flitting about as late as August. They pair, and the female then searches for suitable places for the deposition of her eggs, working her way into dark corners and deep into the folds of garments, apparently choosing by instinct the least conspicuous places. From these eggs hatch the white soft-bodied larvæ (Fig. 33,), each of which begins immediately to make a case for itself from the fragments of the cloth upon which it feeds. The cases are in the shape of a hollow roll or cylinder, and the interior is lined with silk. As they grow, they enlarge these cases by adding material to either end and by inserting gores down the sides which they slit open for the purpose. The larva reaches its full growth toward winter and then, crawling into some yet more protected spot, remains there torpid through the winter within its case, which is at this time thickened and fastened at either end with silk. I have known these larvæ in autumn to leave the carpet upon which they had fed, drag their heavy cases up a 15-foot wall and fasten them in the angle of the cornice of the ceiling. The transformation to pupa takes place within the case the following spring. The heat of a dwelling-house does not seem to affect the development of the pupæ, but the caterpillars remain unchanged till spring even in a highly heated office."

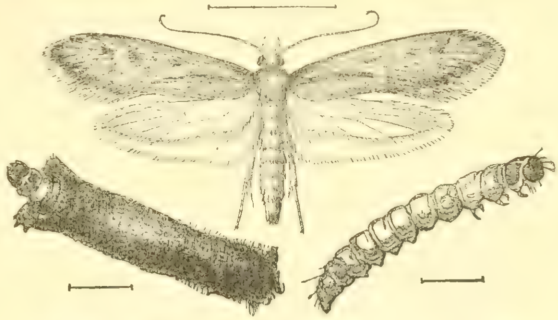


Fig. 33.—*Tinea pellionella* — enlarged. – adult; larva; larva in case (after Riley).

With the exception of the difference in making their cases, the habits and injuries of these species are very similar, and the same remedies will apply for both. A most interesting experiment, demonstrating the manner in which the case of *T. pellionella* is made, can be tried by providing the young caterpillars with different colored materials for making their cases. I have cases showing rings formed from scarlet and black wool, blue peacock's feathers and white lamb's wool.

Perhaps the most remarkable result of the work of any insect which has ever come under my notice, was a piece of a pillow-case which was sent to me by Miss Lucy C. Eaton, of Truro, Nova Scotia. The specimen at first sight has the appearance of beau-

tifully soft grey velvet or short plush. The surface is perfectly even and very smooth to the touch. Since the specimen was received I have shown it to a great many, and until placed under the microscope together with one of the feathers with which the pile was made, it has proved altogether too much for anyone's credulity to believe that it was the work of insects. When magnified, however, the identity of the minute threads of the pile with the portions of the plumules of the feathers with which the pillow-case had been formerly stuffed, is made quite evident. The pillow-case was made of ordinary strong cotton ticking, conspicuously striped with wide blue, and narrow black and red stripes. After the remarkable operation described below the blue and red stripes were entirely obliterated, and the black stripes could only be discerned faintly through the feather felting. Miss Eaton gives the following particulars with regard to this new fabric:

"The pillow was made in the fall of 1889 and was filled with turkey feathers, which as you probably know are very downy near the base, and it is with portions of this down that the pillow is covered. The pillow was made in 1889 and I opened it in the winter of 1891, during that time it had very little actual use. People who slept on this pillow made no remarks about it; but I found it in the morning more often on the floor than in the bed. It remained for about six months in an unused room, when one day thinking nothing of the matter I placed it on my own bed and I found that I actually could not sleep for the noise, which was like something crawling slowly back and forth. I turned it over several times; but it always seemed right under my head. Then I began to think that I had discovered the reason why other people had thrown it on to the floor so often, and I myself threw it out of bed. I then left it alone for about six weeks and tried it again; but the noise was still there. I then put it on one side thinking that when I had time I would open it and get the insects for my collection. It was some time before I found a convenient opportunity, I then took it into an empty room, put a sheet on the floor and cut open the pillow-case and was much surprised to find it in the condition you see by the specimen I send you. The feathers were entirely stripped of their down. It was the insects I was looking for though, so I stirred the feathers up with a stick and the fine particles of down rose in such a cloud, that I was obliged to tie a towel over my nose and mouth to keep from being choked. From the noise that I had heard and the destruction, I looked for an insect about the size of a grasshopper at least; but saw nothing but the little thing I send. There were about a hundred; but I saved only a few. I could not believe that I had found the right insects, I thought they must be larger. I did not actually see the insects alive amongst the feathers but only found the cocoons."

Miss Eaton kindly forwarded me specimens of the injured feathers and also cocoons of the moth *Tinea pellionella*, which she had taken from the pillow. These cocoons show under the miscroscope that they, like the felting of the pillow-case, are also composed of the debris of the injured feathers. The minute bristles of the plumules of feathers, when examined under a microscope show plainly their barbed nature by which they serve so admirably the purposes required of them in causing the plumules to adhere lightly to those touching them in the feather to which they belong; but at the same time allowing the plumules to be separated without injury, and then binding them together again. It is owing to these very barbs on the particles, that the felting of the cotton pillow-case was possible, the feathers having been cut up into fine morsels, these are rendered sufficiently rigid in proportion to their length to work their way through the feathers little by little, every time the pillow is moved, by reason of their barbs which all point one way, until the pillow-case is reached, here, if short enough, they work their way a short distance into the cotton cloth and remain fixed there by their barbs. The beautiful evenness of the pile is, I imagine, due to the fact that unless the particles are very short they will not be

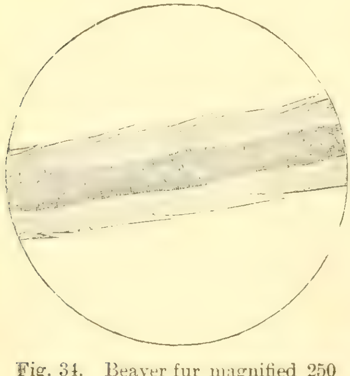


Fig. 34. Beaver fur magnified 250 diameters.

rigid enough to work their way through the feathers and into the cloth. This barbed character is found also in the hair of many animals, and is taken advantage of in the making of felt as was formerly done from the hair of the beaver, for making the shapes of hats. This is fully explained and a magnified illustration, (Fig. 31.) is given, of the hair of the beaver in Mr. Horace T. Martin's new and excellent work "CASTOROLOGIA" where, not only this, but almost every other imaginable information about the beaver is to be found.

Miss Eaton also sent some specimens to the Smithsonian Institution and to the United States Entomologist. In *Insect Life* Vol. IV,, p. 404 the matter is referred to and some interesting data are given of similar work by other insects, as follows: "There is occasionally sent in to the National Museum or the Department of Agriculture, a sample of the felting of bits of feathers into the substance of bed ticking or pillow-casing which is said to have been done by some insect. This felting is frequently very beautifully done, and the inside of the cloth next to the feathers appears like a velvet tissue. Ordinarily the breaking up of the feathers which results in this felting, is done by *Attagenus piceus*, a Dermestid beetle which is particularly fond of feathers. We have just received a very fine specimen from Lucy C. Eaton, of Truro, Nova Scotia, in which the work was done by *Tinea pellionella*, one of the commonest of the northern clothes moths. It must be remembered in these cases that the felting is not done by the insects, but by the mechanical action of the feather barbules themselves. When the feathers have once become broken up into small bits by the action of the insects, then through the constant pressing together of the pillow they gradually work themselves into the cloth covering in which they are held by their microscopic retrorse serrations. To one who looks at a fine specimen of this accidental felting, there can not fail to come the suggestion that feathers could be commercially used in this way. The matter has been occasionally referred to in print, notably in the *American Naturalist* for December, 1882, and in *Insect Life*, Vol. II., pp. 317-318, another instance is given of the felting of a pillow-case from duck feathers which had been destroyed by Dermestid beetles. It is described as being 'entirely covered with a fine growth of down as evenly and thickly as the fur on a mole-skin, which it very much resembles; it is firmly attached, the down breaking rather than pull off."

The editor of *Insect Life* stated at that time: "Pillows in which this felting of the ticking occurs have been infested by one of the Dermestid beetles, (in all of the cases with which I am familiar it has been *Attagenus megatoma*) whose work has resulted in the comminution of the feathers, and the felting results from the subsequent mechanical action. The small feather particles are barbed, as you are aware, and, whenever caught in a cotton fabric by their bases, become anchored in such a way that every movement of the pillow anchors them still further."

In addition to the above the following interesting information is given:

"A similar bit of ticking was exhibited at the Philadelphia Academy of Natural Sciences, April 5th, 1883, and elicited the information that one of the members had some years previously examined a similar material known to have been formed from the fragments of gull feathers, and that a cloak had been made from it which wore well."

With regard to the distinctive differences between these three troublesome immigrants from the old world, it may be well to mention the following points:

1. *Tineola biselliella* is the same insect as has been frequently treated under the name of *Tinea flavifrontella.* This is the commonest species in Canada. The caterpillar spins only a silken path or tube over the surface of, or through, the article attacked. The moth is pale yellow without spots, and when at rest, it holds its wings slanting. Fig. 32.

2. *Tinea pellionella.* The caterpillar of this species from the very first lives within a case, which it carries about with it; the moth is darker in colour with a few black spots on the wings, which lie flat on the back when the insect is at rest. Fig. 33.

3. *Tinea tapetzella.* The caterpillar of this species spins for itself a silken gallery mixed with fragments of the material it is attacking. It remains at all times hidden within this gallery. The moth is easily distinguished from the others by the front wings which are black from the base to the middle and white or gray beyond.

Remedies. With regard to remedies for these troublesome insects, there is nothing better than giving the clothes, furs, etc., a thorough beating and brushing, and then packing them away in spring, if possible before the moths appear. They should be folded neatly and wrapped in strong paper; of course if the edges are pasted, so much the safer. I have seen in the City of Detroit large paper sacks prepared specially to keep out moths, in which dresses can be hung up without folding. In *Insect Life*, Vol. II, page 214, a plan of Mr. L O. Howard's is recommended: "He buys for a small sum from his tailor a number of paste-board boxes in which they deliver suits, and his wife carefully folds and packs away all clothing, gumming a strip of wrapping paper around the edges of the cover so as to leave no crack. These boxes will last for a lifetime with careful use. Others use for the same purpose ordinary paper flour sacks or linen pillow-cases, which answer well. The success of these means depends entirely on the thoroughness of the preliminary work."

As many have found to their sorrow, camphor, pepper, cedar chips, and that abominable malodorant naphthaline, do not kill the insects and are only partially successful in keeping them away.

When carpets are found to be attacked, the furniture should be removed, the carpet thoroughly swept and the edges of the room freely sprinkled with benzine or gasoline. But as both of these liquids are extremely inflammable, great care must be taken, not to take a light into the room until some hours afterwards or until the room has been thoroughly aired. In the case of upholstered furniture or carriage linings, these may be sprinkled freely with gasoline, which will destroy the insects in all stages, and the unpleasant odor soon disappears when the articles are left in the open air. Prof. Riley recommends for carriage linings sponging them with a dilute solution of corrosive sublimate in alcohol, made only just strong enough not to leave a white mark on a black feather. The extremely poisonous nature of this substance, however, demands that the greatest care should be exercised in its use.

For clothes which may have to be used only occasionally during the summer, it is well when the house is known to be infested, to hang them in some place where they will not be forgotten and will be frequently moved.

THE WEB-WORM TIGER (PLOCHIONUS TIMIDUS, HALD).

By Mary E. Murtfeldt, Kirkwood, Mo.

It would seem appropriate that this hitherto somewhat rare and inconspicuous little carabid should be brought to notice in its new *role* of a benefactor.

I have been observing its habits for two years, and am confident that to it, more than to any other agent, do we, in the neighborhood of St. Louis, owe our present comparative freedom from the Web-worm nuisance. Whereas formerly almost every other tree would, at this season of the year, be infested with one or more of the disfiguring nests, they are now so few and far between that it requires some search to find one. I was particularly struck with the difference, in this respect, between this section and the Atlantic slope, on my journey to Washington last August, the eastern woods and orchards being in many places almost defoliated and presenting a very unhealthy and unsightly appearance from the ravages of this insect.

It is impossible, of course, to ascertain just when or how the beetle under consideration acquired the habit of preying upon the Web-worm; but I think it could not have been much previous to its discovery. In 1888 *Hyphantria* was abundant in Kirkwood, and for the purpose of obtaining fresh specimens of the moth, as well as of its usual parasites, I transferred a colony from a box elder tree to the rearing cage. From these a large number of perfect insects were bred and also parasites of two or three species, but no larvæ or imagines of *Plochionus* were observed.

Early in June, 1890, I had been struck with the wasting away of one or two colonies of *Hyphantria* and was about to examine into the causes, when I received from Mr. J. C. Duffey, the Horticulturist of the Shaw Botanical Garden, a note informing me that larvæ of a small carabid had been found in a nest of Web-worms, upon which they were evidently feeding. Accompanying this communication was a box containing one of the infested colonies. Unfortunately the box had been broken in transit, and when I called for my mail the Web-worms were pervading the office, and the distracted postmaster was engaged in a vain attempt to confine them in a newspaper, and expressing himself with some emphasis concerning the sort of mail posted by entomologists. Undoubtedly many of the predaceous larvæ escaped with the caterpillars, but upon examination, after reaching my study, I found seven or eight of the larvæ in the fragments of the web and a sufficient number of Web-worms to afford them sustenance. Placing them on fresh leaves in a small rearing cage on my desk, I soon had ocular verification of Mr. Duffey's interesting observations.

The *Hyphantria* larvæ had all passed the last moult and many were nearly full grown; the carabids were also nearly mature, varying in length from one-fourth to one-third inch, somewhat alligator-shaped, the head provided with sharply pointed trophi, with rather long and strong legs, the body above dark and horny; they had quite a formidable aspect. By preference this larva attacks its victim from the front, biting into the under part of the thoracic segments; but in many cases I have seen it seize hold of the side of a caterpillar, into which it would soon almost bury its head, and not the most violent contortions on the part of its prey were of avail to dislodge it. By the time its appetite was appeased the Web-worm would be fatally injured and a fresh one would be required for its next meal In this way one beetle larva was capable of destroying a great number of the worms in the course of its development. The two species, web-worm and carabid, reach maturity about the same time, the period of carabid adolescence being about one week less than that of the insect on which it preys. The change to pupa takes place both on the surface of the ground and in the remnants of the web on the tree—in the latter case it (being very soft and white and not enclosed) is subject to destruction by birds and other insects. The beetle appears in from eight to ten days after the change to pupa, and requires a day or two to acquire its dark brown color and the firmness in texture of maturity. It is very swift and furtive in its movements and remains hidden as far as possible during the daytime, but is, even in the rearing cage, quite active at night, using its wings freely. It feeds, sparingly, on aphides and similar soft insects. This season I found it in considerable numbers in the two web-worm nests that occurred in our orchard, and to test its destructive capacity I placed thirty-six three-fourths grown *Hyphantria* larvæ in a large glass jar, with three nearly mature *Plochionus* larvæ. A large number of the caterpillars were killed in the course of the following week, and from the three dozen larvæ I bred seven parasites (*Meteorus hyphantria*) and but three moths; the remainder had evidently succumbed to their coleopterous foes, all three of which developed into fine beetles.

I believe the perfect insect occurs sparingly in many sections of the country, but it may not in every locality acquire the habit of preying on *Hyphantria*. It is to be hoped, therefore, that the divergent type will slowly spread from State to State until it, in connection with other predaceous and parasitic species, will practically relieve us of one of our most prominent arboreal pests.

NOTES ON KILLING, PRESERVING AND RELAXING INSECTS.

By James Fletcher, Ottawa.

There is perhaps no statement more frequently made to entomologists by observant travellers, or those who live in localities far removed from civilization, than "O! I wish

you had been with me, I so often saw lovely insects; but I did not know how to save them for you." From novices the enquiry often comes, "What is the best way to relax specimens after they have become dry."

Killing and Preserving. Having collected a specimen the first thing, of course, is to kill it. For beetles and hard-bodied insects nothing is simpler than to drop them for a second or two in scalding water; they must be taken out again at once and dried on blotting paper, or upon a cloth. The easiest way, however, for killing all insects is to make a "cyanide bottle." This may be made either by placing a small quantity of cyanide of potassium in the bottom of a wide-mouthed bottle and pouring in sufficient wet plaster-of-paris to cover it; or a hole can be hollowed out in the cork and a piece of cyanide inserted. This can be kept in a place either with a plug of cotton wool, or a piece of chamois leather or linen may be tied over the cork. It must be remembered that the active principle of cyanide of potassium being prussic acid it is intensely poisonous—any left on hand after the bottle is made should be at once destroyed.

Insects put in this bottle will be killed in a few seconds by the poisonous fumes given off by the cyanide of potassium; they should then be taken out and packed away whilst soft and pliable. After a few days they become dry and are very easily broken. If there are only one or two specimens these may be wrapped in soft paper or cotton wool, and put away in a suitable box. If the collector, however, is likely to get several specimens, it will be well to prepare a box or bottle on purpose. Beetles or bugs may be preserved for a long time in clean saw-dust dampened with alcohol; grasshoppers, ants, wasps, bees, flies, etc., although they are far better preserved by being pinned at once after killing, may be packed away like beetles and bugs in tubes of paper. These are made by winding two or three thicknesses of a strip of paper one and a half inches wide around a lead pencil, leaving about one-quarter inch over the end, which is turned in and pressed flat before taking the case off the pencil. Into this short, hollow tube drop the specimens and turn in the other end with the tip of a pencil, or fill up the mouth with a plug of cotton wool. Several specimens, according to their size, may be placed in each tube, and the date and locality having been written on the outside they are ready to be packed away in a dry place. Being slightly elastic and very light they pack closely, and a large number can be sent by mail at the same time.

Moths, butterflies and dragon-flies may be killed in the ordinary "cyanide bottle," and then placed in three-cornered envelopes made by taking small squares of paper and folding them across, almost in the middle, so as to make a triangular form with one flap a little smaller than the other; when the insect is placed between the two flaps, the two edges of the larger one are folded over the lesser, and the specimen is then ready to have the date and locality written on it and to be packed away where it will not be disturbed.

Relaxing. The easiest way to soften insects is simply to place them in a covered jar upon damp sand for from twelve to fourteen hours. A few drops of camphorated spirits dropped on the sand will prevent mould from forming on the specimens. Pinned specimens can be either placed in the sand jar or pinned upon a piece of cork and floated on water in a closed jar, or in a basin with a damp towel over the top. Butterflies and moths stored in the envelopes mentioned above are best relaxed by putting the envelopes carefully without opening them, between the folds of a damp towel placed between two sheets of glass. The cloth should be wetted and then wrung out as dry as possible with the hands. Fold it smoothly and spread out the envelopes separately between the folds. Small butterflies and moths will relax in twelve hours and the largest in twenty-four hours. Beetles and bugs in paper tubes may be dropped into warm water and will be ready for setting in a few minutes; wasps, bees and flies should be placed in the sand jar to soften. Mr. W. H. Harrington, who uses these tubes extensively for all kinds of insects, finds that specimens can be conveniently relaxed by putting the tubes on a piece of wet blotting paper in the bottom of one saucer with another inverted over the top. The advantage of this plan is that if specimens should be accidently forgotten, or it should be inconvenient to mount them at once, the small amount of moisture soon evaporates, and there is no danger of mould.

THE MOLE CRICKET—GRYLLOTALPA BOREALIS.

BY E. W. DORAN, COLLEGE PARK, MD.

In the Report for last year, page 87, Mr. James Fletcher had an interesting article on his "pet" mole cricket (Fig. 35). At his suggestion I send a few notes upon the larval form of the same species.

On January 4 last, Mr. A. I. Hayward, connected with our State Experiment Station, brought me five larvæ of the mole cricket, which were found in rather a peculiar situation. He had a number of men putting up ice. The ice had been removed from a considerable space, when, wading around in the water with tall rubber boots on, he found the young mole crickets swimming around upon the water. It seems there was no connection between the open space and the land; besides, as the weather was very cold, they could not live upon or near the surface of the ground.

Fig. 35.

The only reasonable theory in regard to the matter is that they were buried in the mud at the bottom of the pond, which is a temporary one, having been flooded with water only a month or two. The wading through the mud dislodged them, when they at once came to the surface. However, there are some difficulties in the way of accepting this hypothesis. For example: Could the crickets exist beneath the water in the soft mud so near the surface for so long a time? Westwood says in regard to the European mole cricket, *G. vulgaris*, that the villose coating of the body and wings appears to protect them from the water. Our species has a similar coating of fine hairs; but in the larvæ especially it seems scarcely sufficient to protect it from the effects of the water in a prolonged submersion. Besides, could it live so long entirely surrounded by water, cut off from the air? They must have been in the thin mud very near the water to have been thus stirred out.

They seemed very little affected by the cold or their bath; in fact, they were as "lively as a cricket," and were apparently very much at home upon the water.

The life history of our American species, *G. borealis*, seems not to have been studied extensively. At any rate I have been unable to find figures or descriptions of the preparatory stages. It is stated that *G. vulgaris* requires three years to come to maturity, and *borealis* seems to be very slow in growth. When these specimens were taken they were but little more than half an inch in length. They are at this time (March 15) about .7 inches long. In two and a half months they have increased in length but little over one-tenth of an inch, though they have been kept in a warm room and supplied with plenty of food, consisting chiefly of the roots of growing wheat, earthworms, etc. As the female deposits her eggs in early spring, they are probably nine or ten months old now. The mature insect is an inch and a half long, while these are but little more than a third as long. Westwood says that *vulgaris* is inactive in winter. These have been active at all times; that is, not in any sense torpid, nor were they when taken.

When I first secured them I put them in a jar of earth, and gave them no further attention for several days. In the meantime one disappeared, and probably served to satiate the appetite of the rest, as they are known to devour their own kind sometimes when they can obtain no other food.

Since then, in exhibiting another before my class, it was accidently injured and died. I shall try to rear the remaining three to maturity, and figure the various stages. I cannot say what stages they have already passed through. The larvæ of *vulgaris* are white before the first moult. These were dark velvety, and had moulted once or twice, I suppose. They have not moulted since.

I have written these notes in the hope of calling out other observations upon the early stages of the insect. And I should be glad to know of any one who has studied or figured the preparatory stages.

THE SONGS OF OUR GRASSHOPPERS AND CRICKETS.

By Samuel H. Scudder.

Everyone is familiar in a general way with the songs of our common meadow grasshoppers and of our crickets. But not everyone is aware that much as with birds each different species may ordinarily be distinguished by its peculiar note or call, if sufficiently close attention is paid to it. Moreover, just as one may recognize in a strange song the general group to which a bird belongs, so in many cases one may tell the group to which a given insect belongs whose note is heard for the first time. Indeed every vocal family of animals utters its distinctive cry. In general the crickets have the highest pitched notes and the short-horned grasshoppers or Acridians the lowest, the long-horned grasshoppers or Locustarians falling between them.

Thus each large family group of the Saltatorial or stridulating Orthoptera* may be recognized by the peculiar pitch of its note. This is perhaps due to the extent of the delicate vibrating membrane of the wings which is brought into action, since this is largest in the crickets and smallest and much broken in the Acridians.

But there is not infrequently some difficulty in distinguishing the song. Indeed in some cases the notes are too shrill to be heard by some ears ; they are beyond their limits of audition. " Crossing the Wengern Alp with a friend ," writes Tyndall in his work on Sound, " the grass on each side of the path swarmed with insects, which, to me, rent the air with their shrill chirruping. My friend heard nothing of this, the insect world lying beyond his limit of audition." So when I first went to Europe and heard the song of an Orthopteran new to me, I asked a distinguished student of Orthoptera, walking with me by the bush from whence a volume of stridulent song burst forth, what genus it was ; but he could hear no sound whatever.

Or, again, the notes may be very feeble and be overwhelmed by the volume of other shrilling in the neighborhood. To distinguish them clearly, one must bring his ear to within a few feet, or even inches, of the insect during its stridulation--a process which requires great caution lest the shyness of the little violinist should overcome his egotistic love of song. The observer must walk quietly toward the sound until it ceases, and wait motionless for its renewal ; the direction of the chirping can then easily be determined, although its distance is deceptive. After drawing an imaginary line towards the spot from whence the sound proceeds, cautious steps must be taken around the arc of a wide circle until another line is fixed at about a right angle to the first, and the location of the songster approximately determined. Then walking quickly but quietly to within five or six feet of the insect, the observer will fall upon his hands and knees, and produce a quill edge and file, which, on being rubbed together, imitate, with great exactness, the note he has just heard. He will begin his mock stridulation after a short delay; at first the sounds must be subdued and separated by considerable intervals, then loud and repeated in quick succession; usually a response is heard before a minute has elapsed, and sometimes it comes at once. When the insect has forgotten his fears and begins to stridulate violently, the observer may cease operations and carefully approach him. In this way one can place himself within a few inches of any species living in the grass.

Orthoptera stridulate in four different ways : first, by rubbing the base of one wing-cover upon the other, using for that purpose the veins running through the middle of the wing ; second, by a similar method, but using the veins of the inner part of the wing; third, by rubbing the inner surface of the hind femora against the outer surface of the wing covers; and fourth, by rubbing together the upper surface of the front edge of the wings and the under surface of the wing covers.† The insects which employ the

* Very few other Orthoptera stridulate at all.
† A modification of this is given below under *Dictyophorus reticulatus*.

fourth method stridulate during flight, the others while at rest. To the first group belong the crickets; to the second the Locustarians; to the third and fourth certain kinds of Acridians. With few exceptions the males alone stridulate. In general terms one may say:

Crickets shrill and creak.

Locustarians scratch and scrape.

Acridians shuffle, rustle and crackle.

In the following pages we propose to pass in review what is known of our American species in this particular, beginning with the crickets and treating the species in systematic order. In doing this we shall have occasion to make our statements perhaps a little clearer by the introduction of a few illustrations, in which a peculiar system of musical notation is employed. It should first of all be explained that this is done only to express the time limits of the song and the rapidity of the successive notes. As the notes are always at one pitch (which, when specified, has been determined by the aid of a piccolo flute), there is, properly speaking, no *song* at all; but it is to the insect what song is to the bird, and so this tropical use of the word may here be allowed. Each bar represents a second of time, and is occupied by the equivalent of a semibreve; consequently a quarter note 𝅘𝅥, or a quarter rest 𝄽, represents a quarter of a second; a sixteenth note 𝅘𝅥𝅯, or a sixteenth rest 𝄿, a sixteenth of a second and so on. For convenience's sake I have introduced a new form of rest (or), which indicates silence through the remainder of a measure.

GRYLLIDAE.

Gryllotalpa borealis Burm. This insect, our common mole cricket (Fig. 35, page 61) usually begins its daily chirp at about four o'clock in the afternoon, but stridulates most actively at about dusk. On a cloudy day, however, it may be heard as early as two or three o'clock; this recognition of the weather is rather remarkable in a burrowing insect, and the more so as it does not appear to come to the surface to stridulate, but remains in its burrow, usually an inch below the surface of the ground. The European mole cricket (*Gryllotalpa vulgaris*), is said to chirp both within its burrow and at its mouth (*plerumque sub terrâ*, Fischer says), and it may be that our species sometimes seeks the air in chanting; but the chirp, as far as I have heard it, always has a uniformly subdued tone, as if produced in some hidden recess. Fischer says that the European species which is twice as large as ours, cannot be heard more than from one hundred and fifty to two hundred feet (*ultra spatium 20-30 passuum*). Ours, when certainly beneath the surface, is easily distinguished at a distance of five rods; and one would presume that it could be heard, if above ground, nearly twice as far away. Its chirp is a guttural sort of sound, like grü or grēēu, repeated in a trill indefinitely, but seldom for more than two or

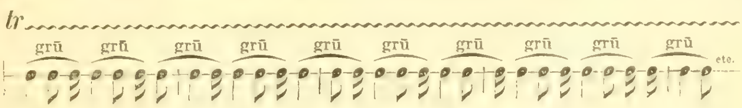


Figure 36—Note of Gryllotalpa borealis.

three minutes, and often for less time. It is pitched at two octaves above middle C, and the notes are usually repeated at the rate of about 130 or 135 per minute, sometimes, when many are singing, even as rapidly as 150 per minute. Often, when it first begins to chirp it gives a single prolonged trill of more slowly repeated notes, when the composite character of the chirp is much more readily detected, and afterward is quiet for a long time. When most actively chirping, however, the beginning of a strain is less vigorous than its full swell, and the notes are then repeated at the rate of about 120 per minute; it steadily gains its normal velocity. Zetterstedt compares the chirp of the European species

to the song of *Hyla arborea.* The note of our own sounds likê the distant croaking of toads (Bufo), at spawning season, but is somewhat feebler. McNeill says he has "been struck with the resemblance of its note to that of *Œcanthus niveus.* To my ear the only discernible difference is that of pitch. This song is a simple chirp, very low in pitch for an Orthopteran, repeated at intervals of about a second." I have also observed its resemto that of Œcanthus, where the latter is heard at some distance.

Gryllus neglectus Scudd. The note of this common cricket, which Saussure regards as only a form of *G. pennsylvanicus* Burm, is *cr-rur-ri*, or *crrri*, or *krrrâ*; the rapidity with which it is uttered seems to vary very much even in a single strain by one insect. Sometimes the notes are produced as slowly as two per second, but they may be twice as rapid ; the mean seems to be the usual rate. The note is sharp and shrill and is apparently pitched at E natural, two octaves above middle C.

Fig. 37.—Note of Gryllus neglectus.

In listening one night in midsummer to the chirping of insects, I heard two choirs. one on either side of me, separated by a garden fence. The individuals of each chirped together at the rate of about two notes per second, but whether owing to the influence of a warmer situation, or a fuller exposure to the moonlight, one choir invariably chirped a trifle faster than the other, and fourteen seconds elapsed between the perfect accord of the choirs and their complete discord ; from this, fourteen seconds more to their former synchronism. These cycles occurred twice per minute, and followed each other with remarkable regularity for about an hour.

The first notes of Gryllus (species undetermined), were heard in Cambridge, Mass,, in 1867, on June 15 ; in 1868 on June 13 ; but in 1880 (if Nemobius was not mistaken for it), on May 16. I think that in New England all fully developed male. that go into hibernation die during the winter and that the earliest stridulation comes from those which have hibernated as pupae.

I may add that when in Cairo, Egypt, early in the month of November, I heard a Gryllus chirping in the early evening when the thermometer was about 67° Fahr. at the rate of about 230 notes per minute ; when three weeks later at the same hour, the thermometer standing at 61° Fahr., the notes were produced by what was apparently the same insect at the rate of only 130 per minute.

Nemobius vittatus Harr. The chirp of this cricket is very similar to that of Gryllus and can best be expressed by *ru* or *rruu*, prouounced as though it were a French word.

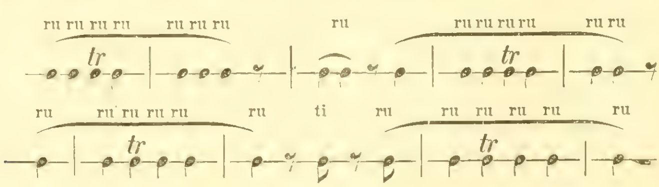


Fig. 38. Note of Nemobius vittatus.

The note is trilled forcibly and lasts a variable length of time ; sometimes for several seconds, at others it is reduced to a short sharp click.

I once observed one of these insects singing to its mate. At first the song was mild and frequently broken ; afterward it grew impetuous, forcible and more prolonged ; then it decreased in volume and extent till it became quite soft and feeble. At this time the male began to approach the female, uttering a series of twittering chirps ; the female ran

away, and the male, after a short chase, returned to his old haunt, singing with the same vigor as before, but with more frequent pauses; at last, finding all persuasion unavailing he brought his serenade to a close. The pauses of his song were almost instantly followed by a peculiar jerk of the body; it consisted of an impulsive movement backward, and then as suddenly forward, and was accompanied by a corresponding movement of the antennæ together and then apart. The female was near enough to be touched by the antennæ of the male during the first movement, and usually started in a nearly similar way as soon as touched.

The tegmina of the male are held at an angle of about twenty degrees from the body during stridulation, and perhaps at a slightly greater angle from each other. Even when most violent, the sound is produced by the friction of the inner edges of the tegmina only, and not by the whole surface.

In different years I have noted the first time in spring that I have heard this creature stridulate in the vicinity of Boston, Mass. In 1869, June 13; 1874, May 31; 1875, May 26 (and the same year at Compton, N.H., June 1); 1878, May 18 (on the summit of Blue Hill, Milton); 1879, May 31. July and August, 1867, were spent north of the White Mountains, at Jefferson, N.H., and no Nemobius was heard there before Aug. 7.

Mr. W. T. Davis says that on Staten Island there is a small form of this species, perhaps distinct, in which the stridulation is "a continuous rolling whirr, instead of the ordinary *creak, creak, creak.*"

Nemobius fasciatus Scudd. I have noticed no difference between the chirp of this species and that of the preceding, of which it is probably only a long winged form.

Œcanthus niveus Serv. The song of the common tree cricket (Fig. 39), consists of a continuously sustained, equable, creaking roll, which varies much in intensity and differs by day and by night. Dr. Harris speaks only of their song by night, remarking: "When arrived at maturity the males begin their nocturnal serenades at the approach of twilight and continue it with little or no intermission till the dawn of day. Should one of these little musicians get admission to the chamber, his incessant and loud shrilling will effectually banish sleep."

Fig. 39.

The day song of this insect is exceedingly shrill, and may be represented by the accompanying figure, though the notes vary in rapidity; when slowest they are about sixteen a second. The song is of varied length, sometimes lasting but two or three seconds, sometimes continuing for a minute or two uninterruptedly; it is a nearly uniform, equally sustained trill, but the insect often begins its note at a different pitch from the normal one—the fourth F above middle C—as if it required a little practice to attain it. When singing the tegmina are raised at fully a right angle to the body. The night song consists of *thrrr* repeated incessantly, three parts of song and one of rest in every three seconds.

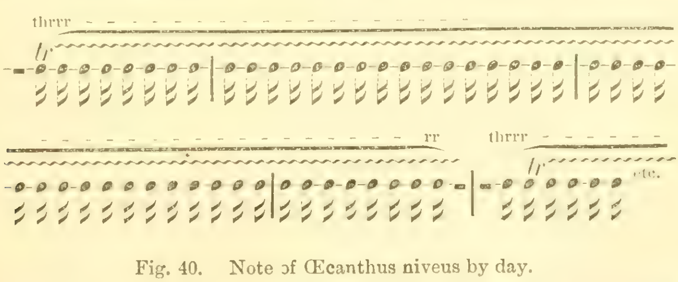


Fig. 40. Note of Œcanthus niveus by day.

McNeill remarks that the day song indicated by the musical notation given above "seems to be the song of *fasciatus*, while the night song certainly resembles that of *angustipennis* more than the song of *niveus.*" These different species were not recognized by me when I made my earliest notes, represented by the notation above, so that a revision of the "score" of our Œcanthus seems desirable.

Davis describes the note of this species as a "*beat, beat*, pulsating sound." Riley says the chirp "is intermittent, resembling a shrill '*re-teat, re-teat, re-teat*' with a slight

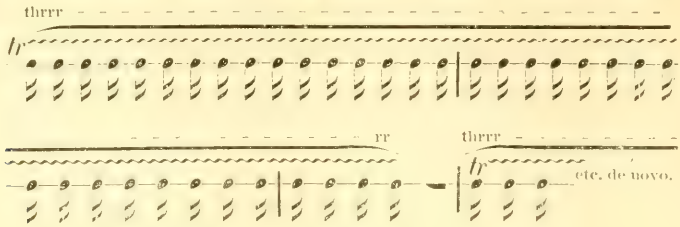


Fig. 41. Note of Œcanthus niveus by night.

pause between each." McNeill calls it "the well-known *trrr ree, trrr-ree*, repeated without variation or pause sixty or seventy times a minute," or as he says in another place "*t-r-r—r-e-e, t-r-r—r-e-e*, repeated . . . . about seventy times in a minute," and adds :

"In the vicinity of Davenport, Iowa, this song is heard as early as the twenty-third of July and it continues until the persistent little songsters are killed by the heavy frosts of the late fall. This song is heard only at night and occasionally on cloudy days, but in the latter case it is only an isolated song and never the full chorus of the night song produced by many wings whose vibration in exact unison produces that characteristic 'rhythmic beat'—as Burroughs has happily phrased it. It is this effect of many united songs that has lead the same author to speak of 'purring' crickets. Thoreau calls it the 'slumbrous breathing' and the 'intenser dream' of crickets, but Hawthorne has given it a more spiritual interpretation than either Burroughs or Thoreau. He describes it as an 'audible stillness,' and declares if 'moonlight could be heard, it would sound like that.'"

Fitch writes of this insect in New York as follows: "In the southern part of our State the song of the flower cricket begins to be heard as early as the first of August, but it is a week later before it commences in the vicinity of Albany, and later still in the more northern parts of the State. Perched among the thick foliage of a grape vine or other shrubbery, some feet up from the ground, and as already stated, remaining in the same spot day after day, its song begins soon after sunset and before the duskiness of twilight arrives. It is distinctly heard at a distance of several rods, and the songster is always farther off than is supposed. Though dozens of other crickets and katydids are shrilling on every side at the same time, the peculiar note of this cricket is at once distinguished from all the rest, consisting of repetitions of a single syllable, slowly uttered, in a monotonous, melancholy tone, with a slight pause between. The children regard the cricket as no votary of the temperance cause ; they understand its song to consist of the words *treat—treat—treat—treat*, which words, slowly uttered, do so closely resemble its notes that they will at once recall them to the recollection of almost every reader. And the song is thus continued without the slightest variation and without any cessation, I think, the whole night through. I, however, have sometimes heard it at the first commencement of its evening serenade uttering three syllables resembling the words *treat, treat, two* ; *treat, treat, two*—as though the songster was supplicating a libation for his voiceless mate as well as himself—a longer pause following each third note. This prelude is probably performed in limbering or otherwise adjusting his organs, preparatory to performing the regular carol, which is struck into in a few moments."

Œcanthus fasciatus Fitch. Of this species McNeill says : "The song is a high trill continuing usually for several minutes with the intervals between the trills of very irregular length. It sings all day as well as all night, apparently in the bright sunshine as well as on cloudy days and in the dusk of evening." Davis calls the song "a long and comparatively loud, continuous whirr often lasting several minutes." My notes, which probably refer to this species, make the chirp to be at a somewhat lower pitch than that given by me for the preceding species, namely, at the third B above middle C, and the song itself is described as more rapid and vigorous. See also the notes under *Œ. niveus*.

Oecanthus latipennis Riley. Riley describes the note as follows: "The shrill cry of *latipennis* is continuous and recalls the trilling of a high-pitched dog-whistle in the distance. The key varies, however, and is sometimes much less high and more musical than at others. The commingled shrills of the species recall also the distant croaking of frogs in the spring. The broad wings are thoroughly elevated during the act, or even bent forward, and the vibration is so rapid that there appears to be no motion." McNeill says: "Its song has been described as a 'continuous, high-keyed trill, continued for fifteen minutes or more.' This is exactly the song of *fasciatus*. Since there has been so much confusion in the species of this genus, there is a chance that the song described above is mistakenly referred to *latipennis*."

Oecanthus angustipennis Fitch. McNeill says of this species, that it "has a song which resembles that of *fasciatus* in some degree, but it is very much fainter and lasts for about five seconds, with an equal interval between the trills." Davis says its song is "a faint continuous whirr, lasting only about five seconds, with an equal interval of rest." See also the notes under *Œ. niveus*.

Anaxipha exigua (Say). Perhaps the same as *A. pulicaria* (Burm.) The only one who has spoken of its song is Davis, who simply says it "has a particular silvery tone."

Orocharis saltatrix Uhl. Riley writes: "The stridulation of this cricket is a rather soft and musical piping of not quite half a second's duration, with from four to six trills, but so rapid that they are lost in the distance. The key is very high, but varies in different individuals and according to moisture and temperature. It most resembles the vibrating touch of the finger on the rim of an ordinary tumbler when three-fourths filled with water, repeated at intervals of from two to four per second, and may be very well likened to the piping of a young chick and of some tree frogs. As the species is very common in the south-west, its chirp is everywhere heard, and is so distinctive that when once studied it is never lost amid the louder racket of the katydids and other night choristers. It is also frequently heard during the day time when the weather is damp and cloudy."

Locustidae.

"These," writes Riley, "are the merry choristers that make our woods and valleys ring with their pleasant songs during the evenings of late summer and early fall. They are chiefly nocturnal in their habits, but not entirely so, for each afternoon during the courting time, and long before the sun has disappeared in the west, a few of them may be seen flying about from place to place, while others are occasionally heard in their retreats as though tuning their instruments preparatory to the grand evening concert."

Scudderia angustifolia, (Harr). This insect is more noisy by night than by day, and the songs differ considerably at these two times. The day song is given only during sunshine, the other by night and in cloudy weather. I first noticed this while watching one of these little creatures close beside me. As a cloud passed over the sun, he suddenly changed his note to one with which I was already familiar, but without knowing to what insect it belonged. At the same time all the individuals around,

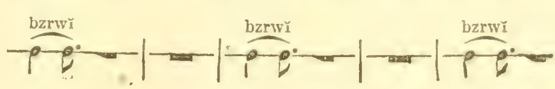


Fig. 42.—Note of Scudderia angustifolia by day.

whose similar day song I had heard, began to respond with the night cry. The cloud passed away and the original note was resumed on all sides. Judging that they preferred the night song to that of the day from their increased stridulation during the former period, I imitated the night song during sunshine, and obtained an immediate response in the same language. The experiment proved that the insects could hear as well as sing. So on another day, at 4 p.m., the sun suddenly beclouded, I heard four or

five individuals close beside me immediately change their note from the day call to the night call.

This species is exceedingly shy, and the observer must be patient who would hold converse with it. One insect which I had disturbed and beside which I was standing could not at first decide to resume his song; he was afraid of the intruder, but, enticed by a neighboring songster, gave utterance several times to a barely discernible short

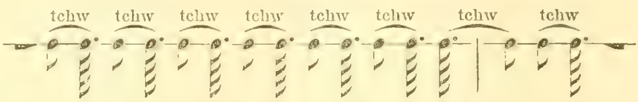


Fig. 43.—Note of Scudderia angustifolia by night.

click or *tĭ*; after five or six of these efforts his desires overcame his fears. The note by day is *tzip* or *bzrwī*, and lasts for a third of a second. The night song consists of a repetition, ordinarily eight times, of a note which sounds like *tchw*. It is repeated at the rate of five times in three-quarters of a second, making each note half the length of the day note.

In 1867 this species and *Orchelimum vulgare* were the first Locustarians to sing at Jefferson, N.H., where I first heard them on July 28.

This species is the *Phaneroptera curvicauda* of my previous notes on stridulation.

Scudderia curvicauda (DeGeer)—Of this species Riley writes: "The shrill of the male is by no means so loud as of the oblong-winged species [*Amblycorypha oblongifolia*], in which its sound is always drowned in the woods. It consists of a softer *zeep*, *zeep*, sometimes uttered singly, but generally thrice in succession. The call is occasionally responded to by a faint chirp from the females, produced by stretching out their wings as if for flight, and is as often heard in the day as at night."

McNeill says: "Its note is not generally heard until the middle of the afternoon. The note cannot be supposed to represent more than the first two syllables of the 'Katy-did' or 'Katy-didn't' of its congeners. It is made but once and the rasping, jerky sound has been very well represented by Mr. Scudder as *bzrwī*," (but this refers properly to *S. angustifolia*, as noted above).

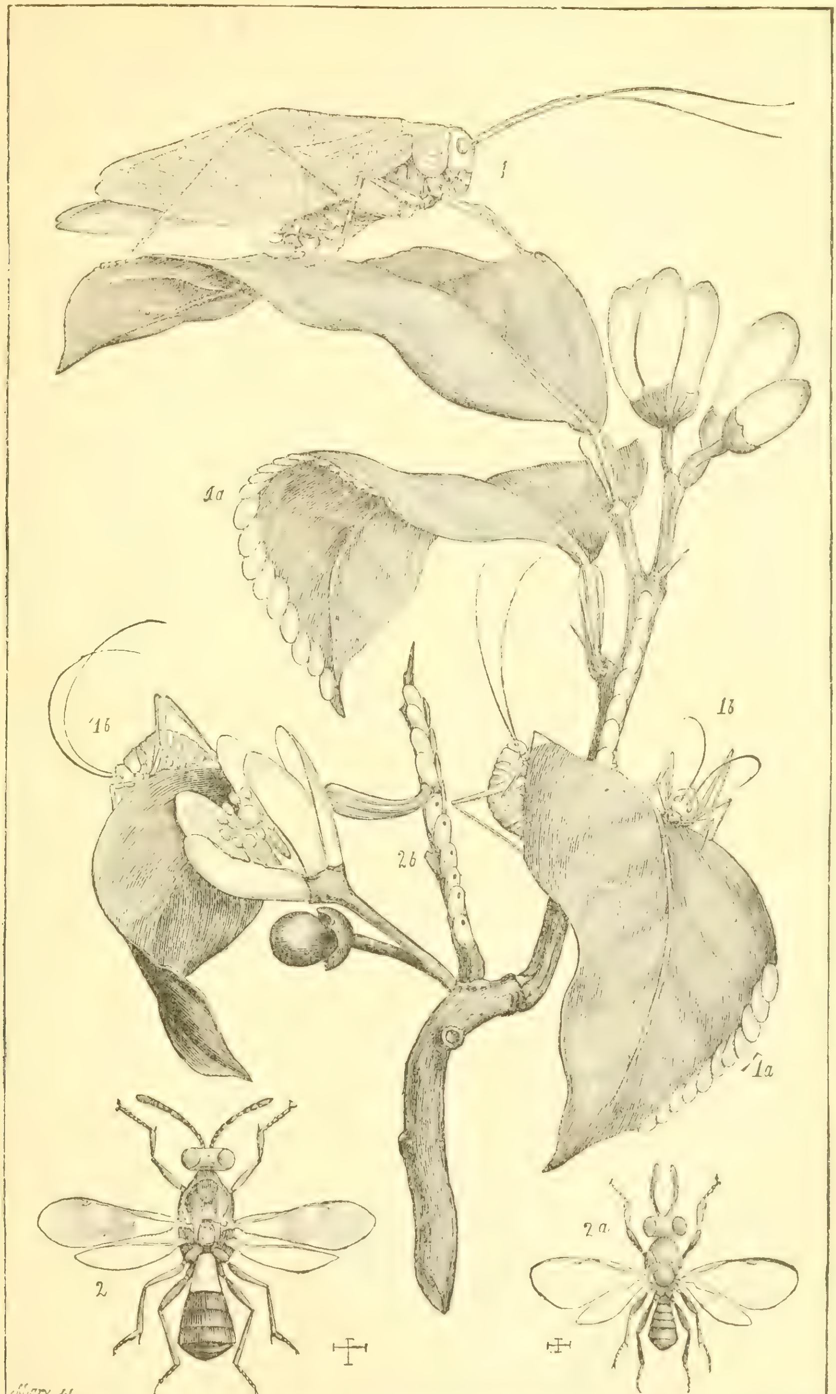
Scudderia furcata Brunn. McNeill says that the note of this species is indistinguishable from that of the preceding species, but is much less frequently heard.

Amblycorypha oblongifolia (DeGeer) Stal. Harris says of this insect that "when it flies it makes a whizzing noise somewhat like that of a weaver's shuttle," but the noise is very feeble and subdued. He adds: "The notes of the male, though grating, are comparatively feeble." I have not studied its note attentively, and only recorded that according to my then recollection it gave three rapid notes in succession like the true katydid, but feeble. One observed subsequently, confined in the house, emitted two notes close together every few seconds, resembling *tch-tch*. McNeill also says that "its note is a quick shuffling sound which resembles 'Katy' or 'Katy-did' very slightly."

Amblycorypha Scudderae Brun.—Bruner says: "Like *oblongifolia*, this katydid produces the peculiar *chick chick* noise which is so characteristic a sound in our groves during the months of August and September."

Fig. 44.—Note of Amblycorypha rotundifolia.

Amblycorypha rotundifolia Scudd.—This insect stridulates both by day and by night and without variation. The song consists of from two to four notes—almost



[Fig. 45.—1, represents the mature winged Katy-did, *Microcentrum retinervis;* 1b, the immature young; 1a and 2b, the eggs, deposited on twigs and leaves, overlapping each other; 2 and 2a, a small chalcid fly parasitic on the eggs, *Eupelmus mirabilis* Walsh.]

invariably three and almost never four—sounding like *chic-a-chee*, repeated rapidly so as to be almost confounded, and when three requiring just one-third of a second ; the song is repeated at will, generally once in about five seconds for an indefinite length of time.

Microcentrum laurifolium (Linn.) McNeill says the note of this grasshopper "may be represented by the syllable *tic* repeated from eight to twenty times at the rate of about four to the second."

Microcentrum retinervis (Burm). Fig. 45. Riley gives an admirable account of this insect in his Sixth Missouri Report, from which the following statement regarding its song is taken :

"The first notes from this katydid are heard about the middle of July and the species is in full song by the first of August. The wing covers are partly opened by a sudden jerk, and the notes produced by a gradual closing of the same. The song consists of a series of from twenty-five to thirty raspings, as of a stiff quill drawn across a coarse file. There are about five of these raspings or trills per second, all alike, and with equal intervals, except the last two or three, which, with the closing of the wing-covers, run into each other. The whole strongly recalls the slow turning of a child's wooden rattle, ending by a sudden jerk of the same ; and this prolonged rattling, which is peculiar to the male, is universally and instantly answered by a single sharp '*chirp*' or '*tschick*' from one or more females, who produce the sound by a sudden upward jerk of the wings."

"Both sexes are for the most part silent during the day, but during the period of their greatest activity their stridulations are never for an hour remitted, from the time the great setting sun hides behind the purple curtains of the west till he begins to shed his scarlet rays in the east—the species being so numerous that the sound as it comes from the woods is one continuous rattling, not unlike the croaking of the frog, but set to a higher key. . . . I have noticed no particular difference in the day and night note, except in the greater intensity of the latter."

Fig. 46.

Davis says of the same species that it "produces two somewhat different songs, or perhaps more correctly, varies the same song in time or extent of utterance, so that unless the same individual is listened to for some time, the notes might be attributed to different species."

Cyrtophyllus concavus (Harr.) Since I began to study the character of the notes produced by different species of Orthoptera, it has been my fortune to hear that of this the true katydid (Fig. 46) but once or twice. This insect lives in tree tops, one or two only in a tree, in little colonies scattered here and there over most of the United States east of the Rocky Mountains. One such colony I encountered in the heart of the city of Springfield, Mass., and spent an evening endeavoring to reduce the notes to scale. The insects which I observed were from fifteen to twenty rods distant, perched in the tops of maple, cherry and elm trees, not far above my window. They ordinarily call "Katy," or say "She did" rather than "Katy did ;" that is, they rasp their fore wings twice, more frequently than thrice ; these two notes are of equal (and extraordinary) emphasis, the latter about one-quarter longer than the former ; or, if three notes are given, the first and second are alike and a little shorter than the last ; the notes are repeated at the rate of two hundred per minute ; and while the interval between two series of notes varies to a certain degree, it is seldom greater than two and one-third seconds, or less than a second and a quarter ; usually it is between one and seven-eighths and two seconds.

The note, which sounds like *xr*, has a shocking lack of melody; the poets who have sung its praises must have heard it at the distance that lends enchantment; in close proximity the sound is excessively rasping and grating, louder and hoarser than I have heard

Fig. 47.—Note of Cyrtophyllus concavus.

from any other of the Locustarians in America or in Europe, and the Locustarians are the noisiest of all Orthoptera. Since these creatures are abundant wherever they occur, the noise produced by them, on an evening specially favorable to their song, is most discordant. Usually, as I have said, the notes are two in number, rapidly repeated at short intervals; perhaps nine out of ten will ordinarily give this number; but occasionally a stubborn insect persists in sounding the triple note; and as katydids appear desirous of defiantly answering their neighbors in the same measure, the proximity of a treble-voiced songster demoralizes a whole neighborhood, and a curious medley results; notes from some individuals may then be heard all the while, scarcely a moment's time intervening between their stridulations, some nearer, others at a greater distance; so that the air is filled by these noisy troubadours with an indescribably confused and grating clatter. This renders special observation of the notes of any individual all the more difficult, and it is only by great patience and careful selection that it can be accomplished, unless one places himself upon the outskirts of a colony.

Harris gave us the first account of this insects' song. He says in his classical Report: "The musical organs of the male consist of a pair of taborets. They are formed by a thin and transparent membrane stretched in a strong half-oval frame in the triangular overlapping portion of each wing cover. During the day time these insects are silent, and conceal themselves amongst the leaves of trees; but at night they quit their lurking places, and the joyous males begin the tell-tale call with which they enliven their silent mates. This proceeds from the friction of the taboret frames against each other when the wing covers are opened and shut, and consists of two or three distinct notes almost exactly resembling articulated sounds, and corresponding with the number of times the wing covers are opened and shut; and the notes are repeated at intervals of a few minutes, for hours together. The mechanism of the taborets, and the concavity of the wing covers, reverberate and increase the sound to such a degree, that it may be heard, in the stillness of the night, at the distance of a quarter of a mile. At the approach of twilight the katydid mounts to the upper branches of the tree in which he lives, and as soon as the shades of evening prevail, begins his noisy babble, while rival notes issue from the neighboring trees and the groves resound with the call of 'Katy-did, she-did' the livelong night."

McNeill writes of it in Illinois: "This is the true 'katydid,' common wherever there are trees. Its song is better known, and the insect itself less known, because of its arboreal habits, than either of the other katydids. This species moves about so little, that it is not unlikely that in many cases an individual spends its whole life upon a single tree. I have listened to the song of one katydid on a certain tree every evening for more than two months. I have noticed repeatedly that on any evening when they are singing, there are the same number of individuals as indicated by the number of songs. · · · So far as I know this is the only species of Orthoptera in which the male is not smaller and more active than the female. It is the only green-winged Locustid with which I am acquainted that does not have the wings longer than the elytra. These facts are not improbably mutually related. It may be surmised that, in the evolution of species, the katydid that developed in the greatest degree its musical apparatus had the least need of hunting up his partner when the mating season came round, and as it was so well protected by its form and color and arboreal habits as to

have little need of wings, these organs have gradually degenerated into a musical and protective apparatus. As the male was released from the necessity of hunting up the female, he would naturally lose after a time his slighter but more active body; it is easy to see how arboreal habits once acquired may react upon the entire organization."

Fig. 48. Note of Conocephalus ensiger.

Fernald says: "I cannot imagine what ingenious person first discovered that their song resembled the words "Katy did," instead of some other words; for many persons besides myself fail, upon hearing them for the first time, to recognize them by their sound."

Conocephalus ensiger Harr. This insect has but a single song and stridulates only by night or during cloudy weather; it begins its song as soon as the sky is obscured or the sun is near the horizon; it begins with a note like *brw*, then pauses an instant and immediately emits a rapid succession of sounds like *chwi* at the rate of about five per second, and continues them for an unlimited time. Either the rapidity of the notes is variable, becoming sometimes as frequent as twenty-three in three seconds, or else there is some deceptive character in its song. In a number of instances I have counted the notes as rapid as the highest rate given above, but on a nearer approach to verify them the rate was invariably reduced to five per second; it is doubtful whether this was due to alarm at my approach, for this is one of the least shy of our Locustarians.

McNeill says "its song is a loud rasping *zip-zip-zip* repeated indefinitely. It does not begin to sing until dark," and in another place he compares the song to the first staccato part of the song of *Orchelimum vulgare.*

Davis writes of it on Staten Island that it is the first Conocephalus to be heard, "and with *ik-ik-ik*, as if sharpening a saw, enlivens low bushes and particularly the corn patch. This insect seems to especially delight in perching near the top of a corn-stalk and there giving forth its rather impulsive song. I have often watched one crawl, with many a spiral turn, up the stem, fiddling all the while. My notes on its first heard stridulation show considerable uniformity, and the average date may be taken as July 15."

Conocephalus nebrascensis Brun. Of this species McNeill writes: "If *ensiger* may be said to sing the first part of the song of *Orchelimum vulgare*, the well-known *zip-zip-zip-ze-e-e-e*, *nebrascensis* may be said with equal truth to sing the last part of the song, that represented by the *ze-e-e-e*; but the sound is much more resonant, being really in quality much more like the song of a Cicada, but not so loud and without a swell. It begins to sing earlier in the evening than *ensiger.*"

Conocephalus robustus Scudd. This grasshopper is exceedingly noisy and sings equally, and I believe similarly, by day and night. The song resembles that of the harvest fly *Cicada canicularis*. It often lasts for many minutes, and seems, at a distance, to be quite uniform; on a nearer approach, one can hear it swelling and decreasing in volume, while there is a corresponding muscular movement from the front of the abdomen backward, two and a half times a second. This is accompanied by a buzzing sound, quite audible near at hand; it resembles the humming of a bee, or the droning of a bagpipe.

McNeil says of this species that "its song is indistinguishable from that of *dissimilis*,"

but the song of the latter has never been described as far as I know*; perhaps he means that of *C. nebrascensis*, which is described by him, as above, in the same paper and which it certainly resembles, to judge from the description. He says further that *C. robustus* "lives both upon trees and in the grass; but while its song may be heard in the grass while the sun is high, I have never heard it from trees until after dark." I have never found it in Massachusetts except in grass or in corn-fields.

Davis says of it on Staten Island that it "resides for the most part mid the grass on sandy ground near the sea shore, though an occasional individual finds its way inland. Along the sea beach they stridulate in early afternoon, especially if slightly cloudy, and when approached they have a curious fashion of dropping to the ground."

Conocephalus exiliscanorus Davis. "Its stridulation," says Davis, "as well as its form, resembles that of *ensiger* more than any other native Conocephalus. We cannot count with any accuracy in *ensiger* the number of times one wing is drawn over the other as indicated by the rise and subsidence in the song, but *exiliscanorus* is such a slow singer that this estimate can be easily made, one wing being rubbed on the other about one hundred and fifteen times in a minute." And in another place: "The sound produced when stridulating is very faint, not louder than that made by *Gryllus abbreviatus*, and I was much surprised to hear such a faint song come from so large an insect. I have, in consequence of this faint song, named it the 'slightly musical" Conocephalus."

Orchelimum nigripes Scudd. McNeill says the song of this species "is difficult to distinguish with certainty from that of *vulgare*, but usually the *zip-zip* is repeated once or twice very rapidly and the *ze-e-e-e-e* does not continue so long. The earliest recorded date for it here [Illinois] is the 1st of August."

Orchelimum silvaticum McNeill. "Its stridulation," says McNeill, "is quite distinct from that of *vulgare*. It consists of the same two elements, but the *zip* is repeated many times very rapidly so as to make almost a continuous sound and the *ze-e-e-e* is comparatively short and very constant, lasting about eight seconds. The first part of the song lasts from three to five seconds."

Orchelimum volantum McNeill. McNeill says of this: "The song has a new note in it. It may be represented as follows: *zip-zip kr-ze-e-e kr-ze-e-e*, the last part of the song not lasting more than a half to three- quarters of a second and is always preceded by the sound which I represent imperfectly by *kr*."

Orchelimum vulgare Harr. With *Scudderia angustifolia* this is the earliest Locustarian to sing in northern New Hampshire; one year it sang there for the first time on July 28; the following year I heard it in the vicinity of Boston July 15. When about to sing on a hot, sunny day, the male mounts a stalk of grass to about a foot from the ground where it clings with its four front legs. allowing its hind legs to dangle on either side the stalk that they may not interfere with the movement of the tegmina. Its song is more complicated than that of our other Locustarians. Beginning with *ts* it changes almost instantly into a a trill of *zr*; at first there is a crescendo movement which reaches its volume in half a second; the trill is then sustained for a period varying from one to twenty seconds (generally from six to eight seconds), and closes abruptly with *p*. This strain is followed by a series of very short staccato notes sounding like *jip!* repeated at half second intervals; the staccato notes and the trill alternate *ad libitum*. The staccato notes may be continued almost indefinitely, but are very rarely heard more than ten times in direct succession; it ordinarily occurs three or four times before the repetition of the phrase, but not more than two or three times when the phrase is not repeated. I have known it to be entirely omitted, even before the repetition of a phrase. The interval between the last *jip!* and the recommencement of the phrase never exceeds one quarter of a second. The night song differs from that of the day in the rarer occurrence of the intermediate notes and the less rapid trill of the phrase; the pitch of both is at B flat.

*Davis says of *C. dissimilis*: "I have found this insect stridulating when its head was gone, picked off perhaps by some vagrant chick!"

Harris says of it: "During the evening, and even at other times in shady places the males make a sharp clicking noise, somewhat like that produced by snapping the point of a pen against the thumb nail, but much louder."

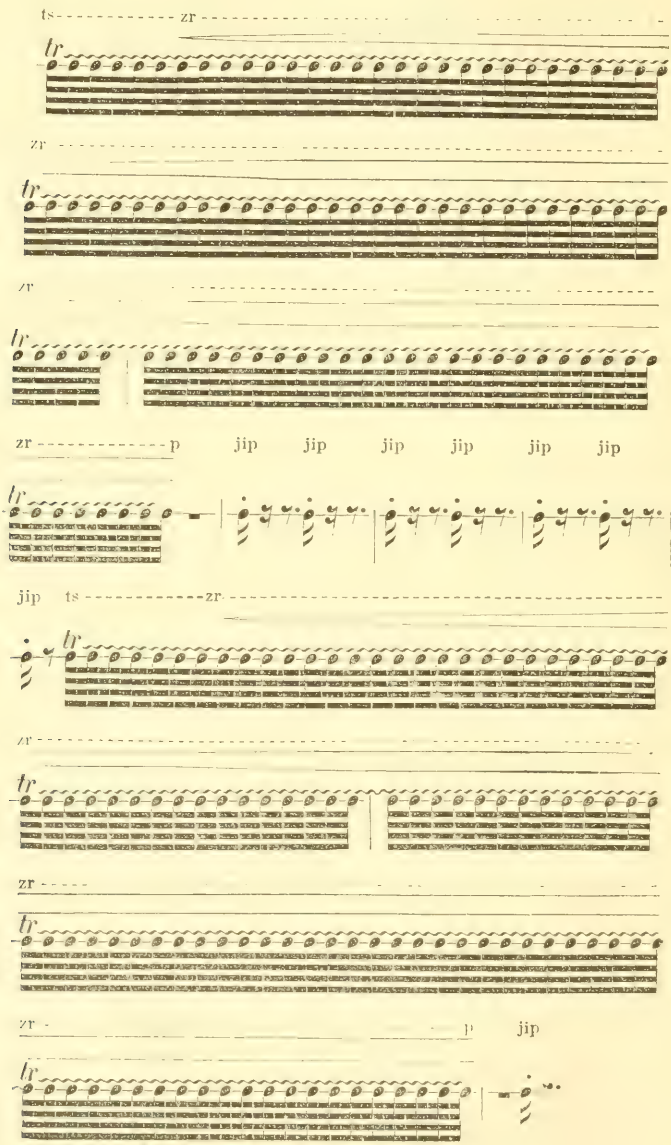


Fig. 49. Note of Orchelimum vulgare.

McNeill, writing of Illinois, says: "I have heard its note as early as the 21st of July. Its song is the familiar *zip-zip-zip-zip-ze-e-e-e*. The staccato first part is repeated about four times, usually about twice a second; the *ze-e-e-e* continues from two or three to twenty or more seconds."

Xiphidium fasciatum Serv. The note of this species resembles that of an Orchelimum, but is very faint. McNeill says of it: "Its song is a faint echo of that of *Orchelimum vulgare* with the *zip-zip* omitted. . . . Its faint little quaver is the first note of the great chorus that sounds in all the meadows from the first of August until the first of October or until cold weather."

Xiphidium nemorale Scudd. "The song," says McNeill, "is louder than that of *fasciatum*; it consists of two parts, the first a short abrupt note which is very well represented by the syllable *zip*, the second is the familiar *ze-e-e* which lasts about half a second and is made from one to five times; the *zip* is not repeated."

Acrididae.

Dictyophorus reticulatus. Many years ago I received a couple of females of this bulky species alive from the south and kept one of them for some time. In the sunshine *she* stridulated by raising her tegmina directly upward against the half opened wings, making a rough scratching sound which was repeated rather rapidly, but variably, from two to ten times.

Subsequently Dr. Shufeldt figured this insect in Science (vol. 2) and gave an interesting account of it from observations in southern Louisiana. He says: "The only sound that I ever heard this grasshopper give vent to is now indulged in by the male. It consists simply of a series of pecular hisses (this word expresses it better than anything else) and is only heard when we seize and handle one of them, or during their mating. The sound seems to be produced largely by the [fore] wings; for these members are elevated at this time, as I have shown them in my plate, where the male exhibits his beautiful hind-wings,—a relief to his otherwise sombre tints that is only to be experienced on such occasions." And later: "Whatever part of the entertainment these sable gentlemen [the males] entered into, they constantly kept up a very audible buzzing racket with their [fore] wings, which they elevated and lowered at few seconds' intervals, showing the inferior carmine pair each time they did so, with telling effect."

Melanoplus femur-rubrum. At Andover, Mass., I once observed on Oct. 5 a pair of this species, male and female, near together alternately answering each other with a slight quick movement of the hind legs on the tegmina as if in stridulation. I made no note of whether any sound was actually produced and do not now recall any.

Chloealtis conspersa Harr. The song of this insect is of varied rapidity, according to the amount of sunshine; in the sun this insect makes from nine to twelve notes, at the rate of fifty-three in fifteen seconds: the usual number of notes is ten. In the shade the

Fig. 50.—Note of Chloealtis conspersa in the sun.

rate falls to forty-three in fifteen seconds, the number of notes remaining the same. The femur is evidently scraped gently upon the tegmina to produce the sound, for frequently, at the beginning, two or three noiseless movements are made, the leg failing

Fig. 51.—Note of Chloealtis conspersa in the shade.

to touch the tegmina. I once found three males singing to a single female, who was busily engaged laying eggs in a stick of wood, her abdomen plunged into a hole she had bored to the depth of half an inch; two of the males were near enough each other to cross antennae.

Stenobothrus curtipennis Scudd. When about to stridulate, these insects place them selves in a nearly horizontal position, with the head a little elevated; they then raise both hind legs together, the hind tibiae bent back snugly against the femora during the movement, and grate the thighs against the outer surface of the tegmina. The first one

Fig. 52.—Note of Stenobothrus curtipennis.

or two movements are frequently noiseless or faint. In sunny weather the notes are produced at the rate of about six a second, are continued from one and a half to two and a half seconds, and when undisturbed are repeated with intermissions of from five to six seconds. When the sky is overcast, the movements are less rapid.

Gomphocerus sp. "The males of several species of this genus," says Riley, "produce a loud rattling or hissing sound, somewhat resembling the rattle of the large gray rattlesnake, by rubbing the inside of the thighs against the elytra." The reverse resemblance is indeed so close that I once stooped to search for the stridulator when I heard the warning of a rattlesnake, but fortunately discovered my error in time to withdraw precipitately. In an undetermined species discovered near Georgetown, Colorado, July 17, the note sounded like *tch*, repeated with exceeding rapidity, while the legs moved very quickly over a very short arc; the repetition was so rapid as to seem like one note, and it lasted from one to two and a half seconds; it was always fainter at the start and strongest just before the end.

Bootettix argentatus Brun. Bruner says this insect produces "a sharp stridulating sound," resembling "that produced by some of the Stenobothri."

Arcyptera gracilis Scudd. This is a very shy insect, but it stridulates more loudly than other Tryxalinae; its note can be heard at a distance of fifty feet. It usually makes four notes, but the number is sometimes greater. The first, a quarter of a second in

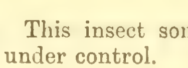


Fig. 53.—Note of Arcyptera gracilis.

length, is duller than the others, and is followed by a pause of a quarter of a second; the other notes are of the same length, but sharply sounded and follow each other rapidly.

Arphia sulphurea (Burm) Stål. This insect sometimes crackles when flying, but undoubtedly the power of doing so is under control.

Chimarocephala viridifasciata (DeGeer) Scudd. This insect usually produces a shuffling or rattling sound uniformly during the whole of its undeviating flight; but the power of making the sound is apparently under control, for it may be frightened into silence.

Encoptolophus sordidus (Burm). Precisely the same may be said of this species as of the preceding.

Tropidolophus formosus (Say) Thom. This crested locust has a short, rather feeble straight flight of about three or four rods in length, the insect rising at once to a height of about six or eight feet from the ground and gradually settling, going with the wind, the distance of its flight being partly determined by the force of the same. During this flight it makes, as if it were not at all under control, a continuous and regular very subdued clicking sound, like the very rapid but somewhat muffled ticking of a watch.

Dissosteira carolina (Linn). Townsend describes what he regards as an act of courtship in this species, as follows: "On the 14th of August last, in the afternoon. I saw one of this species fly up from the dry parched grass, and remain nearly stationary about two feet in the air for some time, by means of a rapid beating of the wings. Presently it flew back to the ground. In a few minutes another one, which had witnessed the performance at a short distance, flew quickly over and alighted by the side of the performer. They ran by each other several times, occasionally touching each other, but did not make any further manifestations, and finally the last one flew away, leaving the other motionless in the withered grass. Though it is probable that the females are attracted by these performances of the males, and that the males vie with each other in their exhibitions, still I think that the two just spoken of were both males, and were disposed to fight from a feeling of rivalry, the one that flew off having been beaten."

"On the 24th of the month I noticed the same thing over again. An individual performed three times in succession, and then another alighted on the ground by its side; they ran by each other several times, apparently clasping, probably in conflict, for I am quite sure they were both males. At last one of them flew away, and the other soon after renewed the performing. I regret to say that I did not capture specimens to ascertain the sex; but, judging from size, I do not think I have seen any but the males taking active part in the aerial exhibitions. In going through with the performance they rise at first generally about three or four feet, making a light purring or beating sound, and then, rising higher, change the motion of the wings, when a curious, sharp, see-sawing sound is produced. Some rise even higher than six feet in the last act; others rise only one or two feet. Of course some excel others in the beauty and ease with which they accomplish the feat; many do not remain in just the same place while hovering, but vary, falling or jerking about while endeavoring to keep the same point in the air. I am of the opinion that the females are sensitive to the grace with which this is performed."

I have repeatedly witnessed this ascent from a single spot, and hovering thereover so well described above, during which an interrupted crackling sound is produced, evidently at will, with particular movements of the wings, but the sound is a muffled one, though decidedly louder and sharper than that heard during its ordinary flight. I have seen it rise to a height of ten feet, particularly when in face of a bank, and it often remains a considerable time in the air nearly stationary or moving slightly up and down.

Spharagemon aequale (Say). This insect stridulates only during intervals of flight, having evidently perfect control in the matter; at nearly every turn it makes in its somewhat wayward flight, it accompanies the swoop with a crackle which lasts but a portion of a second.

Spharagemon bolli Scudd. According to McNeill this locust acts like *Dissosteira carolina* in remaining "stationary a few feet above the ground and in some manner produces a dry rustling note."

Lactista gibbosus. According to Coquillett this grasshopper "sometimes makes a rattling noise while on the wing."

Trimerotropis vinculata. Coquillett makes precisely the same remark of this as of the preceding.

Trimerotropis perplexa Brun. Bruner says "this is a noisy insect and produces a very decided clatter when upon the wing, showing that it is not distantly removed from the various members of the genus Circotettix."

Trimerotropis citrina Scudd. A species which is either this or very closely allied to it was heard by me at Garland, Colorado, making a dull continuous muffled *thrrr* during its short flight.

Trimerotropis columbia Scudd. (Ms.) This dark locust (allied to and perhaps not distinct from *T. suffusa* Scudd.) I heard in Wyoming making during its flight a clacking sound lasting from a quarter of a minute to a minute and a half, made up of a succession of sharp clacks, usually about five per second, but occasionally, and especially just before alighting, hurrying to six per second.

Circotettix verruculatus (Kirby) Sauss. This insect stridulates at will during flight, and is the noisiest of our eastern Acridians. At each turn in its flight, it accompanies the movement with a swoop-like curve, and emits a crackling sound. The sound is like

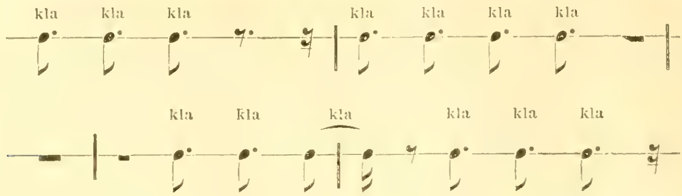


Fig. 54.—Note of Circotettix verruculatus.

kl or *kla* (the *a* having the sound of a in fat), the former at a distance, the latter nearer by; it is repeated at the rate of about five per second; just before alighting, it crackles more rapidly and frequently.

Circotettix carlingianus (Thom.). This Acridian is the noisiest of the family known to me. I have had my attention drawn to it by its obstreperous crackle more than a quarter of a mile away. In the arid parts of the west, it has a great fondness for rocky hill sides and the hot vicinity of abrupt clifls in the full exposure to the sun where its clattering rattle is re-echoed from the walls. Its noise is like that of the preceding species vastly intensified,—a bold and defiant challenge to the collector, who will find him nimbler and warier than he cares for on a hot day.

Circotettix lapidicolus Brun. This is another of the noisy tribe, according to Bruner, who says that "during the hottest, brightest hours of noonday" it "is to be seen and heard in the air, producing its clattering music, which is anything but soothing."

Circotettix maculatus Scudd. This species is a remarkable contrast to the others of the genus. It is much the smallest form and is far from noisy. The sound it makes is similar to that of the other species but very much subdued, so as greatly to surprise me when I first captured it at Truckee, California. I could not at first believe it to be that of a Circotettix.

I have notes of the stridulation of several other western Acridians, but the species are not yet definitely determined and therefore not mentioned here.

AN INSECT DESTRUCTIVE TO SQUASH VINES.

BY SAMUEL H. SCUDDER.

During the month of August the leaves of our squash-vines often present a riddled appearance, disclosing the presence of an enemy. If we examine the edges of the holes we shall find the plump, rounded larva of a beetle feeding sometimes on the upper though generally upon the under surface of the leaf. It belongs to the family of *Coccinellidæ* or lady-bugs; and although, as a general rule, the species of this group are of positive benefit to vegetation in destroying large numbers of plant-lice which blight our fruit and shade trees, a few are herbivorous in nature, and among them the insects of which we are speaking. In the larval state, during which they inflict almost all the injuries of which they are capable, they are of a bright yellow color, covered above with long, branching black thorns, sometimes tipped with white, and arranged in six longitudinal rows. The space between the two middle rows is widened anteriorly by the more lateral insertion of the three first spines. Behind the thorns of the first segment, there is a transverse row

of short, fine, black-tipped hairs. The head, the legs, and the under side of the abdomen are covered with short fine hairs; the tips of the legs are black. When fully grown, the larvæ are about three-eighths of an inch in length, by little less than half an inch in breadth. They crawl but sluggishly, using their terminal segment as an additional leg; and live in large numbers on the squash-vines, where their voracity is attested by the rapidity with which their cast-off skins increase in size and number. These skins are white, transparent pellicles, covered with the characteristic thorns, and preserving in some measure the shape of their former inhabitants.

Toward the latter part of August, or the first of September, the larvæ are fully grown, and begin to change to their pupal state; they stop eating and crawl to a suitable place, generally upon the top of a leaf, where they can fasten themselves by their terminal segments to one of the veins; then slough their skin and appear as pupæ.

The pupa is of the same general color as the larva; the eyes are dusky and the stumpy feet crowded together on the breast. The whole body, but more especially the head, thorax and appendages, is covered with short, simple, black spines. The outer portion of the posterior edge of the first thoracic segment is bordered with black, as are also both edges of the elytra, or wing-covers, though the color fades away before reaching the tips. There are two other black bands upon the elytra, parallel to the first, and nearly uniting as they approach the tip. Between the elytra, at their base, are two little black dots. The edge of the first abdominal segment is marked by two black bands, nearly meeting in the centre, and having each end bent forward; the second, third and fourth segments have a short, black dash upon either side of the outer posterior edge; the fourth and fifth segments are darker than the others; the last segment is furnished with two long, fleshy protuberances, by which the pupa clings to the old, wrinkled, larval skin which still conceals that portion of the body lying beyond the tip of the wing-covers. All the markings which have been described, excepting the two dots between the elytra and the black dashes of the second, third and fourth abdominal segments, are frequently wanting. Out of a large number of specimens which I obtained in Connecticut, scarcely one had any of these markings, while they were invariably present in those examined at Cape Cod.

No similar differences were apparent in the perfect insects reared from the different kinds of larvæ. The pupæ are about one-third of an inch in length by one-fifth in breadth and one-eighth in height, and remain but a few days in the pupal state. When they emerge they do not seem to be possessed of a roving disposition, but may still be seen for several days on the plant where they have spent their lives, and for whose leaves they have still a relish.

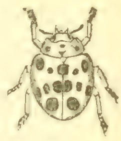


Fig. 55.

In the perfect state these beetles (Fig 55.) are of the same general color as before, although the shade is darker. The elytra have two transverse rows of roundish black spots, five in number, the first row extending across the basal portion, the second traversing the central region; the middle spot in each of these rows is divided by the suture of the wings. In the centre of the remaining apical portion of each elytron is another larger, round black spot; there is a black spot upon the thorax, in the middle of the posterior border; and three other spots, smaller and sometimes fainter, are placed one upon the middle of the anterior edge and the others upon either side of the thorax. The eyes and end of the jaws are black, and the under side of the body is occasionally quite dusky. The whole body is minutely punctured and closely covered with short, fine hairs, invisible to the naked eye; its length is one-third, and its breadth one-fourth of an inch.

This beetle was first described by Thunberg under the name of *Coccinella borealis*, but is now placed in the genus *Epilachna*. Being of so large a size, and affording such evident indications of its presence, this insect can be readily destroyed by hand-picking. There can be no excuse for those who complain of its ravages if they fail to make use of this simple, rapid and effectual expedient—the more rapid and effectual the earlier it is put into practice. Where squashes are grown on a large scale for marketing purposes, it will be advisable to destroy this insect when it appears, by the use of a weak mixture of Paris green and water sprinkled upon the affected leaves.

MISCELLANEOUS NOTES.

AN EXPLODED REMEDY FOR THE PLUM CURCULIO.

We are surprised to notice still going the rounds of the press an account, often with editorial endorsement, of a curculio remedy which has long since been proved unavailing. It con ists in tying corncobs soaked in molasses on the branches of the tree to be protected, and the theory is that the insect will lay its eggs in the sweetened corncobs in preference to laying them in the fruit!

Another of those utterly worthless pseudo-remedies which, we regret to say, has found space in some of our most valuable journals, is of practically the same nature, except that in place of corncobs the writer advises the use of tomato cans filled with a mixture of molasses, vinegar and water.—*Insect Life.*

SUCCESS OF VEDALIA IN EGYPT.

Rear-Admiral Blomfield, to whom we sent several consignments of Vedalia for use against Egyptian Fluted Scale, and whose letters announcing the success of the later consignments we have published from time to time, has written us that the beneficial Australian insect has recently made its appearance in a garden in Ramleh, a distance of more than three miles from the original trees upon which the first specimens were reported. The experiment is evidently turning out very successfully.—*Insect Life.*

ON THE CARBON BISULPHIDE REMEDY AGAINST STORED GRAIN PESTS.

Allow me to add an important item in the method of keeping weevils and rats out of a corn crib, by the use of the vapor of bisulphuret, or bisulphide of carbon.

The improvement I expect to make this year is to place on the floor of the bin an oblong box made out of two 12-inch boards, the upper part coming to a sharp point. The box is to be long enough to run two-thirds through the bin, boxed up at the inner end to give it support. There is to be for a few feet from the inner upper edge an opening cut out about half an inch wide to give free vent for the vapor to penetrate the corn. The necessity of this arrangement is, after the bisulphide has disappeared by evaporation, to replace it with a fresh supply. This is to be done in particular to keep out rats the year round. One good fumigation of the vapor is sufficient to kill the weevils, but it will take somewhat a continuation of the evaporation to keep out rats.

As you are aware, the bisulphide of carbon is a highly volatile fluid, and the contents in an open bottle will readily disappear by evaporation. To replenish the fluid by the use of the long box, say every few months, would be all that is required, and instead of using several bottles at once imbedded in the corn, I would use but a single bottle at a time. By this method the experiment would be brought to a successful issue, and the expense of protecting a bin of corn is not materially increased, but rather diminished.

To place a bottle of bisulphide in the box described, take a wooden shovel with a little box attached to the end of it to snugly hold the bottle. Let the handle be about an arm's length shorter than the box. Before introducing the fluid I would close up the bottle with a few layers of muslin, and by the aid of the shovel place it inside of the box nearly at the inner end, leaving the shovel with the bottle inside; then close up the entrance at the door with old bags or something of the kind.

I learn that some have apprehensions as to the personal safety in using the bisulphide of carbon, and the effect it may have on the corn. As I have ascertained by experiments, the line of ignition is close to the body of the fluid itself, therefore there is no danger in taking a light into the bin. As to the effect on the corn, everything is in its favor. My last year's corn treated with the carbon proved that hardly a kernel failed to germinate, and the shucks were eaten by the stock, I thought, with unusual relish. The

cause of this is obvious. The corn grew rapidly and with vigor, and was considered the best in the neighborhood. Whether the bisulphide had anything to do with it, I will not say; but I am somewhat inclined to think it had. We know that solutions of some of the metallic salts have a tendency to stimulate favorably the growth of seed that is immersed in it.

I only know of one great danger in handling the bisulphide, in which I nearly lost my own life. The experimenter may pour it into the opening of an ants' nest to destroy them, and safely ignite it at the hole with a match. After the explosion it leaves for a while an invisible flame at the opening. If he is tempted to recharge the opening from a full bottle of the fluid in his hands it will explode and send him without a moment's notice into the other world!

It is supposed that nearly 50 per cent. of the corn in Texas is annually destroyed by weevils and rats. The destruction is so great that nearly all the corn used in this part of the State comes from Kansas.—G. P. Hachenberg, M.D., Texas, in *Insect Life*.

WIREWORM REMEDIES.

In answer to a question in relation to destroying wireworms, the larvæ of click beetles, of which there are a large number of species, elaborate experiments by Prof. Comstock, of Cornell University, N.Y., shows that the beetles can be easily attracted to baits of clover which have been poisoned by wetting with one of the arsenicals—Paris green water for instance. These baits consist of small bunches of the freshly cut plant, about one-fourth pound in weight, distributed throughout the field and protected and kept moist by being covered with boards.

As an indication of the efficiency of this method it is stated that a series of twelve traps yielded in three days 482 beetles, or an average of more than forty per trap. These traps should be put out during the early summer, and the beetles killed in a majority of cases will not have deposited their eggs and the consequent depredations of their larvæ, the wireworms, will be greatly diminished. It frequently happens that the infested areas are rather limited in extent, and do not cover the entire field, and where this is the case the labor of distributing bait will be greatly lessened. The bait should be renewed once or twice per week during the early part of the summer. In place of the clover, cornmeal dough and sliced potatoes are used, but clover has proved itself the most valuable. Where a field has become extensively infested by the worms there is little which can be done so far as any actual experiment has shown.

The wireworm is the larvæ of a beetle, commonly known as the click-beetle. This is a small brown or black beetle, and is sometimes recognized from the fact that when placed in any unnatural position it regains its feet by throwing itself into the air by an action of the body which produces a short, sharp, clicking sound. There are, of course, many species of click-beetles, the number being co-extensive with the different varieties of wire worms.—*Prairie Farmer*.

ELECTRICITY *versus* CATERPILLARS.

Edison originated electrocution on a practical scale when he waged successful war on cockroaches. We are greater believers in the humanity of electricity as a destroying agent when thus applied than when used punitively for man. We now hear that Edison's original device has been greatly improved upon, and applied to prevent caterpillars from climbing up trees. Alternate wires of copper and zinc are run around the trunk of the tree, at the distance of about half an inch apart. The casual caterpillar begins to mount the trunk of the tree, and unlimbers himself with the confidence and vigor born of an impending feast. Presently he reaches the copper wire, pokes his nose over it, and lets another kink out of his backbone. Half an inch further up his front feet strike the zinc, the circuit is completed, and the unfortunate larva is a martyr to science.—*Science Gossip*.

INSECTICIDES AND FUNGICIDES.

Many experiments have been conducted with a view to combine substances which are known to have both insecticide and fungicide qualities. While the results have been variable, it would appear on the whole that the combination of an insecticide does not add to the efficiency of a fungicide, but often detracts from it; but the reverse of this does not hold true, as experiments have proved that while Bordeaux mixture combined with arsenites does not act well as a fungicide, it is decidedly beneficial as an insecticide, as the arsenites can be used so much stronger. Professor Maynard found that one pound of Paris green in 500 gallons of sulphate of copper solution proved very injurious to his trees, but that one pound of Paris green in 200 gallons of Bordeau mixture secured a very large crop of plums while other trees not treated lost their fruit from curculio. He also decided that black knot was less upon the trees sprayed with this latter mixture.—*Dr. C. V. Riley; Address before the Massachusetts Horticultural Society.*

ARSENITES IN THE ORCHARD.

Recent experiments made at a few of our experiment stations, which have sufficiently competent Entomologists, have thrown much light on the comparative value of different arsenical mixtures as insecticides, and as to the relative injury they do the foliage of different trees. The testimony of some experimenters would indicate that the peach is more susceptible to the influence of London purple than to Paris green, and that there is less danger of injury when the leaves are young than when they are old. The cause of injury by London purple is doubtless due to excess of soluble arsenic. Professor Bailey found that heavy spraying with one pound of Paris green to three hundred gallons of water did not injure the foliage. But perhaps the most valuable results obtained are those given by Professor Gillette, who states that London purple used with Bordeaux mixture in the proportion of one pound to fifty gallons was entirely harmless to the peach and plum; that the oldest leaves are most liable to injury; that dews and probably direct sunlight increase injuries done by arsenites to foliage; that leaves kept perfectly dry can hardly be injured by them; that leaves suffering from fungous disease are more susceptible than healthy ones; that freshly mixed and applied London purple is most injurious, while freshly mixed and applied white arsenic is least injurious to foliage, but the longer the mixed white arsenic stands the greater the danger of injury; that lime added to London purple or Paris green in water lessens the injury they will effect on foliage, while lime added to white arsenic in solution increases the liability to injure the same unless the poison is wholly dissolved, when the opposite effect is produced; that London purple can be applied without injury, eight or even ten times as strong, if combined with common Bordeaux mixture instead of water; that arsenites cannot, by ordinary methods, be mixed in a kerosene emulsion; that they mix readily in rosin compounds and seem no more injurious than when applied in water; that when put into strong, soapy water they do much more harm than in clear water; that they mix readily in carbonate of copper solution and are as harmless as when in clear water; that London purple in sulphate of copper solution is vastly more harmful than when in water only. —*Dr. C. V. Riley; ibid.*

THE FLUTED SCALE.

No more striking event has happened during the past two years than the extermination of this insect, most destructive to the orange growing interests in Southern California. It is difficult for one unfamiliar with the facts to realize that this scale, which two and a half years ago hung like a blight and plague over leaf, branch and trunk of all citrus, and many other kinds of fruit trees and shrubs of Southern California, has been so effectually swept away by the little Australian lady bird, Vedalia cardinalis, which was imported for this purpose. In the language of Assistant Secretary Willits, "It seems almost like an entomological romance." The history of this scale Icerya purchasi, has made everything pertaining to the genus interesting and during the past year four other

species have come to my knowledge. The Icerya rosæ from Key West and limited in its range; Icerya Ægyptiacum, from Alexandria, Egypt; Icerya Montserratensis occurs on the island of Montserrat, W.I., and Icerya Palmeri, found by Dr. Edward Palmer, in 1887, upon a grape vine in the province of Sonora, New Mexico, but only on the Muscat of Alexandria variety. The practical lesson to be learned is, that our fruit growers of Florida, Texas and California should take every care to quarantine all plants from infected foreign points until examination shows them free from such pests.—*Dr. C. V. Riley*; *ibid.*

USEFULNESS OF TOADS.

At Greeley, Colorado, two species of leaf-roller moths were very abundant and destructive in their attacks upon fruit and other trees. Mr. Gillette in closing his observations upon them says: "While speaking of the remedies for leaf-rollers, I should do wrong not to mention the valuable services of the toads. One of the most interesting sights that came under my observation in Greeley last summer was the large number of well-fed toads that hopped lazily about on the walks under the trees from morning to night, looking for leaf-roller caterpillars that were dropping on every side. The rollers were usually snapped in by the toads even before they could reach the ground. As many as fifty of these toads were counted under a single tree, and it was not uncommon for people to take the middle of the street to avoid the toads along the walk. Toads seldom do harm and feed almost entirely upon insects, and should be carefully protected as they are decidedly beneficial."—*Colorado Bulletin No. 19.*

BOOK NOTICES.

A Text Book of Agricultural Entomology: Being a guide to the Methods of Insect Life and means of prevention of Insect Ravage. For the use of Agriculturists and Agricultural Students. By Eleanor A. Ormerod. Second Edition—London: Simpkin, Marshall & Co., 1892. One vol., pp. 238; 164 figures; Crown 8vo.

About nine years ago Miss Ormerod delivered a series of ten Lectures for the Institute of Agriculture in England, and afterwards published them in book-form as "A Guide to Methods of Insect Life." This proved to be an excellent and highly useful work, but was not in much demand until recently, when it was found to contain the information that was required in this department of agricultural instruction, and accordingly the necessity of a second edition speedily arose. The result is the work before us, in which the authoress has expanded her original lectures and produced an admirable text-book for the use of students and others interested in Economic Entomology.

The first two chapters of the book give an account of the structure and transformations of insects, describing their varied conditions of life in the larval, pupal and perfect states, and a brief explanation of the various orders and their characteristics. Any intelligent reader will get a very fair elementary idea of Entomology by studying these two chapters, and they are written so clearly and in such simple language, as free as possible from technicalities, the few employed being always explained—that they can be fully grasped by any one of the most ordinary attainments.

The next two chapters deal with Flies (*Diptera*) and Fleas (*Aphaniptera*). The principal species that cause injury to the farmers by their attacks upon his crops and live-stock are treated in detail, and the best modes of opposing their ravages are clearly and succinctly given. In describing the Wheat Midge (*Cecidomyia tritici*) the authoress says: "*In Canada, or where the weather can be reckoned on* and the date of appearance of the Wheat Midge can be reckoned on also, injury from attack is avoided by sowing so that the wheat shall flower *before* or *after* this special time. In one case the young grain is too firm for the Red Maggot to hurt it; in the other, the flower and germ is not far enough advanced for there to be anything to attack until the Wheat Midge has passed

away ; consequently the corn is safe. We sometimes benefit in this way here [in England] by accidental circumstances, but we cannot depend on being able to arrange it as in less changeable climates."

"Our best method of prevention is to destroy the Red Maggot (or the Chrysalis, if it has turned to it) in its winter shelter. Deep plowing, such as will turn infested stubble thoroughly down, will act well, for once deeply buried the Gnat-fly either will not develop or *cannot* come up again. It is not enough considered in these matters that we may by our own common knowledge often guide ourselves. If a weak small grub (so small that we can scarcely see it) has a weight of earth put on it, somewhere about as much as if at least thirty or forty yards deep of earth were placed on one of ourselves, it is very unlikely that, where it is not specially supplied with powers for piercing the ground, it will come up again as a grub ; and the Gnat-Midge, if it does develop, certainly cannot make its way through."

"This is one of the points that show us how to keep insects in check ; we need often merely to consider just what is before our eyes and act on it. Once down, and left down (for, of course, if we bring the grubs up again by a second *equally deep plowing* we lose our labor), we have, in all probability, buried the coming attack safely away."

But while giving such information as this on methods of prevention of insect attacks the authoress distinctly disclaims any intention of making the book a Manual of Economic Entomology, and expressly states that the details of treatment are given in order to impart the principles on which the treatment is based. "There are certain habits," she says ; "certain times when the creature is inactive ; certain treatment which will get rid of it equally in the egg, or the chrysalis state, and so on. Therefore, though I hope the short histories may be serviceable for field use further on, yet now these points are entered on chiefly as showing general methods of treatment that we may apply to all similar kinds of attack."

From the account of the Ox Warble fly (*Hypoderma bovis*) we extract the following : "The yearly loss from this attack is enormous. Firstly, there is the loss on milk, and on many other points of damage consequent on the wild gallop of the cattle when terrified by the fly. Secondly, there is the loss on condition of the infested animal. Every warbled hide is a sign of so much out of the farmer's pocket, for the food he spent in feeding grubs in his cattle's backs, which should have gone to form meat and milk, instead of being wasted in foul maggot-sores. Thirdly, there is the loss falling mainly on the butchers, consequent on damage to surface of carcase known as 'licked beef' or 'butcher's jelly.' Fourthly, there is a great loss on the injured hides." In proof of this she quotes some returns from dealers in hides ; one from Newcastle-on-Tyne states that "in a period of twelve months, 102,877 hides passed through the market ; of these 60,000 were warbled. Loss estimated at £15,000."

"The above loss, in all its details, is wholly unnecessary. By the use of simple measures we have now found, from the experience of our leading farmers, cattle-owners and veterinary surgeons, during about nine yeas, that the attack may to all practical purposes be stamped out."

"Squeezing out the maggots is a sure method of getting rid of them ; but they may be destroyed easily and without risk by dressing the warble with any thick greasy matter that will choke the breathing pores of the maggot, or poison it by running down into the cell in which it lies and feeds. . . . To prevent fly-attack in summer, train-oil rubbed along the spine, and a little on the loins and ribs, has been found useful ; so has the following mixture : 4 oz. flowers of sulphur, 1 gill spirits of tar, 1 quart train oil ; to be mixed well together and applied once a-week along each side of the spine of the animal. With both the above applications it has been observed that the cattle so dressed were allowed to graze in peace, without being started off at the tearing gallop so ruinous to flesh, milk, and, in the case of cows in calf, to produce." (The above would, no doubt, prove valuable as deterrents to one new pest, the Horn-fly).

The fifth and sixth chapters are devoted to Beetles (*Coleoptera*), and contain a clear outline of their classification with short descriptions and excellent figures of a large number of representative injurious species, and the best modes of dealing with them.

The next chapter treats of Butterflies and Moths (*Lepidoptera*). After giving an account of many different species with their varied modes of attack and the special measures to be adopted in each case, the authoress goes on to say: "But for the most part these and various other means of prevention or remedy have to be applied, not as broad measures of treatment, but as *special* measures for each *special* attack, involving necessarily *special* outlay. For these reasons the pressing need has long been felt of having some kind of application at hand which is cheap and sure in its action, and which can be brought to bear at once, when required, on any or all sorts of Moth-caterpillars together (whatever their various natures or previous histories may have been), and will kill the whole collection of ravaging hordes at once, without damaging the leafage; the experiments have been made, which have resulted, in some of our fruit-growing districts, in the successful introduction of spraying caterpillar infested leafage with Paris green, which has long been found serviceable in the United States and Canada." To Miss Ormerod, indeed, it is due that the British fruit-growers have been introduced to the use of arsenites, that their prejudices have been largely overcome, and that the successful experiments have been carried out. For several years she has been urging in her Reports the adoption of spraying with these poisons and using kerosene emulsions, and now the good results of acting upon her advice have become apparent in many quarters.

Chapter eight treats of Saw-flies, Ichneumons, Wasps and other members of the order *Hymenoptera*. Especial attention is paid to the beneficial species of Ichneumons that are parasitic upon various insects of all kinds. The next chapter deals with the Bug tribe (*Hemiptera*), including the Aphides and Scale-insects (*Homoptera*) and the Plant-bugs (*Heteroptera*); and the last chapter with Slugs, Eel-worms, Millepedes and Red-spider. In this concluding chapter there is given much sensible advice for ordinary people as to the way in which they should observe insects and deal with their attacks. We may make one or two quotations: "With a slight knowledge of the habits of insect life, added to his own of the agricultural measures that could be used to destroy the pest, or at least lessen the effect of its ravages, each grower would be fairly able to cope with attacks as they occurred; whereas if he depends only on advice, besides the damage from delay, he is very likely to get suggestions not suited to the particular circumstances. The farmer may not know the history of the insect; but on the other hand, the Entomologist very seldom knows the practical workings of growing a crop, which it is necessary to know before advising measures which can be depended on to answer at a paying rate."

"In many cases the different items of treatment which go to make up good farming will of themselves keep down a great deal of insect attack. By good cultivation of the soil, and proper as well as liberal manuring, by rotation of crops, and clearing fields and borders of useless trash and weeds, we turn out a great quantity of the pests which are harboring in the ground, and also ensure a good, healthy growth, such as will support the crop under moderate attack; and by the rotation of crop and absence of weeds we are often able to present starvation to our grubs, as many of them will only (or, perhaps, we should say, *can only*) live on special food. These are the broad principles which are sure to be of use. We shall not be free from insects any more than we shall be free from weeds; and we need a great deal more solid field information about the habits of crop insects (and experiences of paying means of prevention) before we can think we have them thoroughly in hand. Nevertheless, the last few years have added enormously to our information, and have shown us how at least we may greatly diminish the amount of injury our crops suffer."

This stock of information, as far as Great Britain is concerned, has been almost entirely brought together by the unselfish labors and painstaking enthusiasm of Miss Ormerod herself. While aided by a large number of practical observers scattered over the country, she stands alone among hundreds of collectors of insects, and many eminent students of entomology, in devoting her talents, her knowledge, her time and her means to the most useful and patriotic pursuit of the study of the science in its economic aspect.

C. J. S. B.

Special Report of the State Board of Agriculture on the Extermination of the *Ocneria Dispar*, or Gypsy Moth. Boston: Wright & Potter Printing Co., 1892.

This official pamphlet gives an interesting account of the very remarkable and unique efforts that are being made in the State of Massachusetts to exterminate the Gypsy Moth. This insect, imported from Europe, was accidentally permitted to establish itself about twenty years ago, and has now multiplied to such an extent as to be a serious pest throughout a considerable area of the State. In March, 1890, the Legislature passed an Act appointing three Commissioners to "provide and carry into execution all possible and reasonable measures to prevent the spreading and secure the extermination of the *Ocneria Dispar* or Gypsy Moth in the Commonwealth;" the sum of $25,000 was also appropriated for the work. Last year the Commission was merged into the State Board of Agriculture, and a further grant of $50,000 was made to it. The Report before us gives the details of the work carried out and the modes adopted for waging war against the insect. They were very largely under the direction of Professor Fernald, as Entomological adviser, and Mr. Forbush, as Superintendent of Field Work. The number of men employed varied with the season, and at one time, in June last, was as many as 242. The work began with the destruction of the eggs; when these proceeded to hatch out, spraying the caterpillars with insecticides was adopted, and towards the close of the season the eggs were again made the objects of attack. An enormous number of the insects were destroyed, and a perceptible diminution in the amount of injury was observed in some places. We shall look forward with great interest to the result of the present year's operations, and hope in time to be able to record a great victory in this field of practical Entomology. C. J. S. B.

Insects Injurious to Forest and Shade Trees, by Alpheus S. Packard, M.D., Ph.D. (Fifth Report of the Entomological Commission of the United States). 1 vol., 8vo., pp. 957. Washington: Government Printing Office, 1890.

About ten years ago (in 1881) what was then called the Entomological Commission, consisting of Messrs. Riley, Packard and Thomas—three very eminent men—issued a work by Dr. Packard on "Insects Injurious to Forest and Shade Trees" (Bulletin No. 7), a goodly volume of 275 pages, well illustrated and replete with valuable information. Recently a revised and much enlarged edition of this publication has been issued by the Department of Agriculture at Washington, bringing the original work more nearly down to date, and furnishing, as far as possible, a complete manual on the subject. The new volume is more than three times the size of the former edition, consisting of no less than 950 pages, illustrated by over 400 wood cuts and forty plates, twelve of which are colored Some idea of the extent of the work, as well as of the importance of the subject, may be found from the fact that descriptions are given of over three hundred species of insects that affect the oak, and the names of nearly one hundred and fifty more are mentioned; sixty-one are described as attacking the elm, and thirty more mentioned; one hundred and fifty-one described that affect the pine, and a list of twenty more given; and so on for a large number of other trees. Economic entomologists for the most part devote their attention to the insects that attack fruit trees, crops and vegetables, as these most directly affect the public; but surely no more important matter can be studied than the preservation of our forests, which are annually being depleted for the purposes of commerce, as well as by fire and insects. It is high time that more attention was paid to this matter, and that people generally should be aroused to the dangers that will surely result if we allow our country to be stripped of its woods and forests. In some countries of Europe, notably in Germany, a very rigid oversight of the forests is maintained by the government, and no wanton or careless destruction is permitted. In connection with this, they encourage scientific men to devote their studies to the insect enemies of trees, and as a result some magnificent books have been published, chief among these are the grand work of Ratzeburg and the perhaps less widely known publications of Kaltenbach. Alongside of these Dr. Packard's book will assuredly take its place, as his work is very carefully and completely done. The life-history of each insect described is as far as possible fully given; the best published descriptions of each stage are quoted and references given wherever the author

has not made personal observations himself, or wherever he thinks that some one else's record is better or fuller than his own. Thus the work is made complete to date, and succeeding observers will know what investigations have been made, and what remains to be done in this vast field of entomological research. The colored plates are beautifully and accurately done, and the wood cuts and other illustrations give careful details or full representations of a large number of the insects referred to in the text. Such a publication ought to encourage our own Government to follow the noble example set them in this respect at Washington. C J. S. B.

A Series of Thirty Colored Diagrams of Insects Injurious to Farm Crops. Drawn from nature by Miss Georgiana E. Ormerod. W. & A. K. Johnston, London, England, 1891.

These diagrams are beautifully and accurately executed, and will be found most useful by anyone who is called upon to lecture to classes in entomology, or give addresses to farmers' institutes. They are sufficiently large, being thirty inches long and twenty-two wide, to be seen at some distance in a hall or class-room, and will serve to illustrate descriptions of an economic character. Though intended for England, nearly all of them are equally applicable to this country. They are divided into five sets of six each, which deal with the following objects:—(1) Common Insect Attacks: Ox Warble Fly, Horse Bot-fly, Large White Butterfly, Cockchafer, Turnip Flea-beetle, Onion Fly; (2) Insects affecting Various Kinds of Crops: Surface Caterpillars, Daddy Long-legs, Eel-worms, Plant Bugs, Hessian Fly, Wire-worm; (3) Insects Affecting Particular Crops: Mangold Fly, Hop Aphis, Bean Beetle, Corn Thrips, Gout Fly, Corn Saw-Fly; (4) Insects affecting Fruit Crops: Winter Moth; American Blight (Aphis), Gooseberry and Currant Saw-fly, Apple Blossom Weevil, Codlin Moth, Magpie Moth; (5) Insects Affecting Trees: Pine Beetle, Pine Weevil, Pine Saw-fly, Goat Moth, Spruce Gall Aphis, Leopard Moth. The diagrams are sold singly at one shilling and sixpence each, or in sets. On each is shown the natural size of the insect as well as the greatly enlarged picture, a very necessary matter, as otherwise most erroneous impressions are formed by the ignorant of the real dimensions of the creature referred to. There is also printed on each a general description, by Miss Eleanor A. Ormerod, of the life history of the insect depicted, and of the best remedies to be employed against it.

C. J. S. B.

A Manual of North American Butterflies, by Charles J. Maynard: 8vo., pp. 226. Boston, DeWolfe, Fiske & Co., 1891.

We are always glad to welcome the publication of a new book which is likely to render more easy, and consequently to popularize, the study of entomology. The author of the work before us has, no doubt, had this object in view when preparing this manual, in which are brought together "for the first time, descriptions of all the species of butterflies which occur in North America, North of Mexico." He has evidently taken a great deal of pains in the execution of his task, and expended much labor upon the descriptions of over six hundred and thirty species of butterflies, and in the preparation of the illustrations, for "not only is a colored plate given of one species of nearly all the genera, but wood cuts are given of some portion of about two hundred and fifty species, illustrating some peculiar character by which the insect may be known; both plates and wood cuts have, with a single exception, been drawn and engraved by the author himself." The wood cuts, giving a wing or a portion of a wing, of a number of closely allied species, will be found very useful helps by any one employing the book for the identification of his specimens, and are much superior to the coloured plates. Anyone with a large stock of specimens on hand, and with a few named in different genera to start with, will find this book a very useful and handy manual for the naming of his material, but this, we fear, is the extent of its value. The author has adopted the comparative method in his descriptions, which involves a constant reference to some other species, which the beginner in the study may chance not to have, and be woefully puzzled in consequence. There are no synopses, or comparative tables, of either genera or species given, but the author selects a species as his "type" and compares the other members of the genus with it. If the student possesses a specimen of this typical

species his way will be fairly easy, but without it the investigation will be sadly difficult, if not hopeless. Another very serious defect in the book is the entire absence of all reference to the preparatory stages of the insects, and consequently to their food-plants, habits, dates of appearance, etc. We trust that the author may be enabled to issue a second edition of the work, and make it a thorough and complete "manual" by remedying the defects we have referred to. That this may be done in a concise form and in a most useful manner is admirably proved by Stainton's "Manual of British Moths and Butterflies," which we would commend to our author as a model for imitation when he enters upon the preparation of his next edition. C. J. S. B.

OBITUARY.

The Abbé Provancher.

It is our painful duty to record the death, in his 72nd year, of the Abbé Léon Provancher, who for many years, despite great discouragements and disadvantages, laboured zealously and assiduously to develop and disseminate a knowledge of the natural history of Canada, and especially of his native province. He was born in 1820, at Beçancour, Que., and for some years was Curé of Portneuf, and one of his earlier entomological writings was a list of the Coleoptera of that district. Compelled by enfeebled health to relinquish the regular and more active duties of the ministry, he removed to Cap Rouge, near Quebec, and devoted his remaining time and strength almost entirely to the study of the natural sciences. In 1869 he commenced the publication of the *Naturaliste Canadien*, and, notwithstanding many discouragements, completed in 1891 the 20th volume, when its issue had reluctantly to be abandoned through the Quebec Government refusing to continue the scanty annual grant it had received. As early as 1858 Provancher published an elementary treatise on botany, and in 1862 his Flore du Canada. Subsequently he devoted his attention specially to entomology, and in 1874 commenced his Faune Entomologique du Canada—Vol. I., treating of the Coleoptera, was completed in 1877, with three supplements in 1877, 1878 and 1879. Vol. II. was commenced in 1877 and completed in 1883, and contains the Orthoptera, Neuroptera, and Hymenoptera. In 1885-1889 he published Additions aux Hymenoptères, and issued Vol. III. upon the Hemiptera, which was completed in 1890. He was also an enthusiastic conchologist, and his last publication was a treatise upon the univalve molluscs of the Province of Quebec. His writings include the account of a pilgrimage to Jerusalem, an excursion to the West Indies, treatises on agriculture, etc. He will be best known, however, by his entomological work, and as he described a large number of new species and genera, particularly of the Hymenoptera and Hemiptera, it is sincerely to be hoped that his collections may be placed where the types will be carefully preserved and be accessible to students of entomology. There is a disposition on the part of some American students to ignore the work of Provancher, and to accuse him of want of care, etc., in the determination of genera and species. The enormous disadvantages under which he labored must, however, be considered, for he was remote and isolated from libraries, collections and fellow-workers, and in his writings he often laments the fact that so few could be found to take any active interest in his pursuits, or to assist him in his labors. His entomological work would have been more exact and complete had not the publication of the *Naturaliste* greatly interrupted his investigations, and forced him to spend much of his time in other directions. His labors had the result of starting natural history collections in some of the colleges in the Province of Quebec, but our French citizens do not appear to have any special leaning to the sciences he loved, and he has left behind him no entomological student of any distinction. Above all, Provancher was an ardent Canadian, strongly imbued with love of his race, language and religion, and often in his writings he impresses these sentiments upon his readers. A few years ago he was elected a Fellow of the Royal Society of Canada, and he was also a member, active or honorary, of many other societies. W. H. H.

DIV. INSECTS

TWENTY-FOURTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF

ONTARIO

1893.

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY.

TORONTO:
WARWICK BROS. & RUTTER, PRINTERS, 68 AND 70 FRONT ST. WEST.
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TRADE MARK

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EDITOR of *The Canadian Entomologist*, 1868-1873, 1886-1894.

TWENTY-FOURTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY OF ONTARIO

To the Honorable the Minister of Agriculture:

SIR,—I have the honor to present herewith the twenty-fourth annual report of the Entomological Society of Ontario, which shows that good progress has been made in every line of work that it has undertaken. While I should not omit to refer to the maintenance of the Society's world-wide reputation as one of the leaders in Economic Entomology, it is worthy of mention that the local interest and membership of the Society shows a decided increase, proving that the methods adopted by the Society for the attainment of its ends are well suited to the purpose.

I have the honor to be, Sir,

Your obedient servant,

W. E. SAUNDERS,

Secretary.

OFFICERS FOR 1894.

President	W. H. Harrington	Ottawa
Vice-President	J. W. Dearness	London.
Secretary	W. E. Saunders	do
Treasurer	J. A. Balkwill	do
Directors :		
Division No. 1	James Fletcher	Ottawa.
" 2	Rev. C. J. S Bethune	Port Hope
" 3	Gamble Geddes	Toronto.
" 4	A. H. Kilman	Ridgeway.
" 5	R. W. Rennie	London.
Librarian and Curator	J. A. Moffat	do
Auditors	J. H. Bowman	do
	J. M. Denton	do
Editor of the "Canadian Entomologist"	Rev. C. J. S. Bethune	Port Hope.
Editing Committee	J. Fletcher	Ottawa
	H. H. Lyman	Montreal.
	Rev. T. W Fyles	South Quebec.
	J. M. Denton	London.
	J. H. Bowman	do
Delegate to the Royal Society	Rev. T. W. Fyles	South Quebec.

ANNUAL MEETING OF THE SOCIETY.

The thirty-first annual meeting of the Entomological Society of Ontario was held in its rooms in Victoria Hall, London, on Wednesday and Thursday, October, 11th and 12th, 1893. In the absence of the President, the chair was occupied by Mr. J. M. Denton, the Vice-President.

The meeting was called to order at 3 p.m., when the following members were present: Rev. T. W. Fyles, South Quebec; J. Fletcher, Ottawa; Rev. C. J. S. Bethune, Port Hope; J. M. Denton, R. Elliott, J. A. Balkwill, H. Stevenson, J. A. Moffat, R. W. Rennie, G. F. Sherwood, W. McClement, W. J. Stevenson, W. E. Saunders, London, and others. Letters of regret for their inability to attend were read from Mr. W. Hague Harrington, Ottawa, the President; Mr. H. H. Lyman, Montreal; Mr. A. H. Kilman, Ridgeway.

REPORT OF THE TREASURER.

The Treasurer, Mr. J. A. Balkwill, presented the annual statement of the finances of the Society, as follows:

RECEIPTS, 1892-93.	
Balance on hand for last year	$ 319 13
Members' fees	297 51
Sales of *Entomologist*	66 07
" pins, cork, etc	55 78
Advertisments	12 03
Government grant	1,000 00
Interest	10 64
	$1,761 16

EXPENDITURE, 1892-93.	
Printing	$ 542 05
Report and meeting expenses	231 60
Library account	31 35
Purchase of collection	50 00
Expense account (postage, etc.)	63 04
Rent and fuel	40 00
Insurance	35 00
Salaries	300 00
Cork, pins, etc	10 58
Balance	457 54
	$1,761 16

We have examined the books of the Entomological Society of Ontario, compared them with vouchers and find them correct and affirm that the above statement is in accordance therewith.

(Signed) Jas. H. Bowman, W. E. Saunders, } Auditors.

London, Ontario,
October 10th, 1893.

The Treasurer explained the various items of receipts and expenditure, and explained that the balance on hand, $457.54, though apparently larger than usual, would all be absorbed before the end of the year by the printing and other accounts; the item of $50 for the "purchase of collection" was the last instalment of the amount due to Mr. Moffat, and that this sum would be available for the benefit of the Library next year. He urged very strongly that some date should be fixed upon for the close of the Society's financial year, and that it should not depend upon the time of the annual meeting, which varied very considerably from year to year. After the Report of the Treasurer had been adopted, and a vote of thanks for his services unanimously carried, it was resolved, after some discussion, on motion of Mr. Saunders, seconded by Dr. Bethune, that the financial year of the Society should in future be closed on the 31st of August, except when the annual meeting was held earlier than that date.

REPORT OF THE LIBRARIAN AND CURATOR.

Mr. J. A. Moffat presented and read his report as follows :

I beg leave to submit the following report for the year ending 31st of August, 1893 : Seventy volumes have been added to the Library during the past year.

Several bound volumes were received from Governments and public institutions, the most important of which are : The Report of the New York State Museum ; The Report of the Ontario Game and Fish Commission (Illustrated) ; The Mammals of Minnesota (Illustrated) ; The Annual Report of the Smithsonian Institution ; The 10th Volume, Proceedings and Transactions of the Royal Society of Canada ; The 17th Report of the Geology and Natural History of Indiana ; The Hawks and Owls of the United States (beautifully illustrated).

Those added by purchase are: Gray's Manual of Botany ; Scudder's Guide to Butterflies ; The Life of a Butterfly, S. H. Scudder.

The whole number now on the register is 1,284. The number of volumes issued to local members was 46.

Several interesting additions were made to the native collection of Lepidoptera. A few attractive things were added to the exotics.

A box of beetles was kindly sent to the Society by Mr. Trevor C. D. Kincaid, Olympia, Washington State, which have been placed in a drawer by themselves, and the donor's name attached.

A small but interesting and valuable collection of Rocky Mountain Butterflies has been loaned to the Society by Mr. T. B. Parkinson, one of our local members. They were taken by Dr. W. Hayden, Canmore, and presented by him to Mr. Parkinson.

Through the kind consideration of Prof. C. H. Fernald, Amherst, Mass., the Society has been put in possession of a complete life series of the Gypsy Moth, *Ocneria dispar*, Linn.

The valuable English collection had suffered severely from insect pests. By a liberal use of white crystallized napthaline, the work of destruction was at once arrested, and is now completely overcome. I find this material to be a clean, safe and certain preventive, and even a complete exterminator of insect pests.

Respectfully submitted,
J. ALSTON MOFFAT.
Librarian and Curator.

REPORT FROM THE ENTOMOLOGICAL SOCIETY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA.

BY W. HAGUE HARRINGTON, DELEGATE.

I have the honor, as duly appointed delegate from the Entomological Society of Ontario, to submit a brief report on its operations during the past year. It is very satisfactory to state that, after a highly useful existence of thirty years, the Society flourishes with unimpaired vigor, and that its members continue with unabated zeal, the investigation of the insect fauna of our vast territories to the gain both of science and of the agricultural industries of the country.

The *Canadian Entomologist*, the official organ of the Society, completed, during 1892, its twenty-fourth volume, and the demand for admittance to its pages was so great that they were increased from the standard number of 240 to no less than 323. There were fifty-two contributors to the volume ; among them many of the most prominent entomologists of Canada and the United States.

In the systematic papers were published descriptions of five new genera, and ninety-six new species of insects ; chiefly Diptera, Lepidoptera and Hymenoptera. Of more than ordinary interest were some of the articles on collecting, breeding, geographical distribution, classification, etc.

The following were some of the more important papers published during the year:

Can Insects Survive Freezing? Mr. H. H. LYMAN.

Entomology for Beginners—Three papers, Mr. J. FLETCHER, Mr. H. F. WICKHAM.

Descriptive papers on N. A. Diptera, Mr. C. TYLER TOWNSEND.

Notes on Coleoptera, Dr. JOHN HAMILTON.

Orthoptera of Indiana, Mr. W. S. BLATCHLEY.

Miscellaneous Notes on Butterflies, Larvæ, etc., Mr. W. H. EDWARDS.

Getting Butterfly Eggs, Mr. W. G. WRIGHT.

Classification of North American Spiders, Mr. NATHAN BANKS.

New North American Homoptera, Mr. E. P. VAN DUZEE.

New North American Microlepidoptera, Prof. FERNALD.

Canadian Galls and their Occupants, Mr. WM. BRODIE.

Four Insect Monstrosities, Mr. H. F. WICKHAM.

Insects attracted by Fragrance or Brilliancy of Flowers for purpose of Cross-Fertilization, Dr. R. E. KUNZE.

The Inhabitants of a Fungus, and Life History of Xenos, Mr. H. G. HUBBARD.

A full report was also published of the meeting of the Entomological Club of the A.A.A.S., including the very valuable address of the President, Mr. E. A. Schwarz, which dealt very thoroughly with the work hitherto accomplished in North American coleopterology. When to the foregoing contents are added the book notices of current publications on economic and systematic entomology, correspondence and records of varieties and rare species, obituary notices, etc., the result is a volume of much value and interest to all who are interested in the study of insect life.

The society also furnished to the Ontario Department of Agriculture the usual annual report (No. 23) which consisted of 88 pages, with numerous illustrations. In addition to a full report of the proceedings at the annual meeting of the society, it contained some valuable special papers, of which may be mentioned the following:

A Visit to the Canadian Haunts of the late Philip Gosse, Rev. T. W. FYLES.

A Trip to Mount Washington, Mr. H. H. LYMAN.

Notes on the Rarer Butterflies of the Province of Quebec, Rev. T. W. FYLES.

On the Power of Insects to Resist the Action of Frost, Mr. J. A. MOFFAT.

Some Injurious Microlepidoptera, Mr. J. A. MOFFAT.

The Hornfly, Mr. JAMES FLETCHER

Clothes Moths, Mr. JAMES FLETCHER.

The Songs of Our Grasshoppers and Crickets, Prof. S. H SCUDDER.

The thirteenth annual meeting of the Society was held in its rooms in London, on Wednesday, August 21st, and Thursday, September 1st. The President, the Rev. Dr. Bethune, F.R.S.C., delivered a very valuable address, in the course of which he discussed those insects which had been reported as most numerous and destructive during the year. Interesting papers were also read by several members, and reports were received from the Geological, Botanical, Ornithological and Microscopical Sections, and also from the Montreal Branch, which for many years has regularly brought together for mutual instruction the students of entomology in that city and vicinity.

The Society was honored during the year in the election of Rev. Dr. Bethune to the distinguished position of President of the Entomological Club of A. A. A. S., and Vice-President of the Association of Economic Entomologists.

TWENTIETH ANNUAL REPORT OF THE MONTREAL BRANCH OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

The council beg to submit the following report of the work of the Branch during the session of 1892-93.

Eight monthly meetings have been held and the following papers have been read:

Notes on Zaraea Americana, Rev. T. W. FYLES.

A Trip to Mt. Washington, H. H. LYMAN.

Notes on the Lepidoptera of Cap a L'aigle P. Q., A. F. WINN.

Preparatory Stages of Anisota Pellucida, H. H. LYMAN.

Life History of Nemeophila Scudderii, H. H. LYMAN.

Notes on Taxonus Dubitans and T. Nigrosoma, J. G. JACK.

Notes on Collecting Sesiidæ in the London (England) District, L. GIBB.

List of Lepidoptera collected by Dr. Bell in the Country North of Lake Huron, H. H. LYMAN.

We have, since our last annual meeting, lost another of our members who was an enthusiastic worker in the study of insects, by the death of Mr. J. W. Cushing.

Your council regret that the attendance at the meetings during the past season has not been as good as in former years, and would urge on the members the necessity of doing all in their power to increase the interest of the meetings and to endeavor to add to our roll as many new names as possible.

The report of the Treasurer shows a balance at our credit of $19.24.

Submitted on behalf of the council.

(Signed) H. H. LYMAN,
President.

The following officers were elected for the ensuing year:

President, H H. Lyman; Vice-President, L. Gibb; Sec.-Tres., A. F. Winn; Council: J. F. Hausen, H. B. Cushing.

Regret was expressed that no member had been able to represent the Society at the annual meeting of the Association of Economic Entomologists held at Madison, Wisconsin, in August. (Through the kindness of Mr. Howard, a full account of the proceedings has been received and will be found in subsequent pages of this report.) At the meeting of the Entomological Club of the American Association for the Advancement of Science, held at the same place, Mr. Lyman, of Montreal, one of our members, was present, and read a paper on *Hepialus Thule*.

A paper entitled "Notes and Queries," by the Rev. Dr. Holland, of Pittsburg, was read by Dr. Bethune; the writer referred especially to the occurence of *Erebus odora*, *Papilio cresphontes* and *Philenor* and other insects. In the discussion that followed, it was stated by Messrs. Moffat and Saunders that they found *P. cresphontes* in abundance about London, and also its larvæ. Dr. Bethune reported having taken it at Roach's Point, Lake Simcoe, on the 28th of August last. He mentioned also the capture at Port Hope, on the 15th of October, of a male specimen of *Colias Eurytheme*, the first that he had seen in that neighborhood. *Papilio philenor* had formerly been taken near Toronto and Hamilton, but not of late years; its larvæ had been found at Ridgeway feeding upon Wild Ginger, *Asarum Canadense*.

Mr. Fletcher exhibited an illustration of a gall on *Negundo aceroides* made by a moth, and described its peculiarities; also specimens of *Silpha bituberosa* from Saskatoon. Some larvæ were recently sent him from there, which were feeding upon *Monolepis chenopodioides*, an abundant plant in the prairie region; from these he bred the beetle, *S bituberosa*.

Mr. Elliott exhibited some galls found on Hackberry, *Celtis occidentalis*, which are probably the work of a Psylla. This elicited a discussion on the very remarkable distribution of the tree in Canada, which occurs in small numbers in isolated localities, as for instance at Como, P.Q., Ottawa, Bowmanville and the neighborhood of London.

Mr. H. Stevenson showed an interesting prickly gall from the wild blackberry, *Rubus villosus*, which was probably produced by a *Rhodites*.

The Rev. T. W. Fyles read a paper on "Notes of the year 1893." In the discussion that followed, Mr. Fletcher stated that he had found *Telea polyhemus* on Cornus; he had also found *Catastega aceriella* very abundant on maple trees at Ottawa. *Nisoniades Horatius* was this year quite common on Columbine (*Aquilegia*); of *Argynnis triclaris* he had taken seven specimens near Ottawa, a butterfly that hitherto has only been known to occur in the barren lands of the Peace River.

Mr. McGill exhibited his patent Composition Tree-protector, which is very simple in construction, easy to apply and an excellent defence against canker-worms, and also useful as an attractive hiding-place for codling worms and other larvæ.

The meeting adjourned at 5.30 p.m.

EVENING SESSION.

In the evening the Society held a public meeting in its room in Victoria Hall at 8 o'clock, which was largely attended by members and other friends from London and the vicinity. In addition to those already mentioned as present in the afternoon, the following were noticed: Rev. Dr. Andras, Mr. J. Foote, Dr. Woolverton, Dr. Wilson and others. The chair was taken by Mr. Denton, the Vice-President, who apologized for the unavoidable absence of Mr. Harrington, the President of the Society.

REPORT OF THE COUNCIL.

The following report was then read by the Secretary and adopted:

The Council of the Entomological Society of Ontario beg to present the following report of the proceedings of the Society during the past year. The membership of the Society shews a considerable increase over that of last year, especially in the addition of a large number from the Province of Ontario. Much interest has continued to be taken in the various departments of the Society and much satisfactory work has been accomplished.

The Twenty-third Annual Report on practical and general Entomology was presented to the Minister of Agriculture in November last, and was printed and distributed early in January. It consisted of eighty-eight pages and was illustrated with forty-five wood cuts. The report contained, among other interesting matter, a remarkable paper by Mr. S. H. Scudder on "The Songs of our Grasshopers and Crickets"; a long and interesting account by Rev. T. W. Fyles of "A visit to the Canadian Haunts of the late P. H. Gosse," which was especially noticed by the Toronto *Globe* of April 6th, and other newspapers; also a timely article by Mr. Fletcher on the Horn fly.

The *Canadian Entomologist* has been regularly issued at the beginning of each month and completed its twenty-fourth volume in December last. It consisted of 323 pages, being the largest number yet issued. Ten numbers of the twenty-fifth volume have been published, each averaging twenty-six pages. The Council take this opportunity of thanking their numerous contributors, among whom are included all the leading Entomologists of North America, for their valued assistance, which has enabled them to maintain the position held for so many years of being one of the leading Entomological journals of the world, as well as the best in America. The library has been increased by the addition of seventy valuable works, making the whole number of volumes in the rooms of the Society nearly thirteen hundred.

A considerable number of rare specimens have been added to the collections, and the Council have pleasure in again acknowledging the careful and painstaking services of the Curator, Mr. J. Alston Moffat, who has at all times shown his readiness to assist the members, and particularly beginners, in the identification of specimens and the prosecution of their studies.

Interest in the various sections engaged in the study of the allied sciences of Botany, Microscopy, Geology and Ornithology, has not flagged, a number of new members having been added to the Society through this channel, and good work accomplished in each branch. Reports from the sections are submitted herewith and will be found to give an outline of the work undertaken.

The annual report of the Treasurer shows a present balance of $457.54, which amount will be scarcely sufficient to meet the expenses of the Society during the winter session, but by careful economy it is hoped that the expenditure will not exceed the balance in hand to any great extent.

The Society was represented at the meeting of the Royal Society of Canada, which was held at Ottawa in May last, by your President, Mr. Harrington, whose report is presented herewith.

All of which is respectfully submitted,

(Signed) W. E. SAUNDERS, Secretary.

In the absence of the President, Mr. JAMES FLETCHER, Dominion Entomologist, gave a highly interesting address upon the chief insect attacks of the year, which was listened to with great attention.

INJURIOUS INSECTS OF THE YEAR.

BY JAMES FLETCHER, OTTAWA.

I regret that the President has been prevented from being here to day to deliver his annual address. I am sure that some very important business in connection with his office has caused his absence, as I know that he fully intended to be present. I am glad to be able to report that no serious new pests of the farm have made their appearance during the past season, and with the exception of the Horn-fly and three species of Locusts, generally known under the collective name of "Grasshoppers," none of the old enemies have shown themselves in unusual numbers. Of household pests the common Clothes Moth (*Tineola bisetliella*, Hum) was for some reason extremely abundant and injurious in many parts of the Province. Two of the most interesting attacks which have been brought under my notice are : (1.) The gall-making larva of a small moth which passes its larval life in the young twigs of the ash leaved maple, *Negundo aceroides* Several specimens of the swollen twigs containing caterpillars were sent to me from Mr. W. G. Fonseca, of Winnipeg, who has observed the insect for some years. I was able to breed the moths this year as well as two distinct parasites. None of these have yet been named. About half the larvæ were found to be parasitised. (2.) The other attack alluded to is of the larvæ of one of the Carrion beetles, *Silpha bituberosa*, Lec., upon squashes and chenopodiaceous plants at Saskatoon in the North-West Territories. In England a closely allied species, *S. opaca*, is sometimes a serious enemy of the beet-root. It is this fact which gives the present record importance, from the possibility of *S. bituberosa* developing a taste for cultivated plants as the country becomes more settled. The larvæ are nocturnal in their habits, black, half an inch in length, shaped like wood-lice and are very active. I received the larvæ when nearly full-grown and soon afterwards they buried themselves in the earth. About two weeks later the beetles

emerged. At first I took them for the European species, which, however, it is said, also occurs in this country, but Dr. George H. Horn has kindly identified them for me as *S bituberosa*, a native species of the North-West Territories. It is probable that the usual habit of this insect as well as of *S. opaca* is to feed upon carrion ; but the fact that they occasionally develop a taste for vegetation makes it necessary to be on guard against them.

Cut-worms were as usual complained of in various districts, the species most commonly sent in being *Carneades messoria*, Harr. (Fig. 1) in onion-beds, *C. ochrogaster*, Gn., omnivorous and *Noctua fennica*, Tausch, chiefly in clover and pea fields. The easy remedy of wrapping a piece of paper around the stems of freshly planted tomatoes and cabbages is becoming very popular amongst those who have tried it. In my own experience I have found it one of the most satisfactory remedies. It is done at the time of planting, is very easy and takes hardly any time. The easiest way is to have a bundle of paper all cut to the right size, about three inches square. Thread these close to one corner on a loop of string and tie this to the basket or box in which the young plants are carried to the field. Before planting a cabbage, pull off one sheet of the paper and lay it on the palm of the left hand, then taking the young plant in the right hand place the stem across the paper and close the left hand. this will leave a loose collar of paper around the stem between the top and the root. When planting leave about two inches of the paper above the ground.

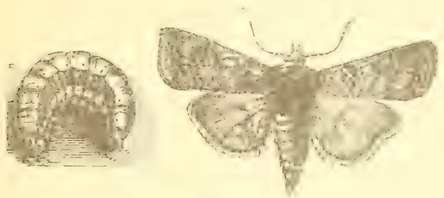

Fig. 1.

The *Turnip Flea*. On the whole, there have been fewer complaints of the flea beetle (Fig. 2) this season than for many years. The best remedy is to dust the young plants as soon as they appear above the ground with a mixture of land plaster and Paris Green in the proportion of 25 to one. The land plaster acts as a stimulant to the young plants and soon pushes them past the stage when they are liable to injury from the beetles. The mixture must be perfectly dry. Leaf-hoppers of various kinds have been abundant in some localities and upon various crops. *Erythroneura vitis*, Harr., the Leaf-hopper of the Vine sometimes called "The Thrip," has been successfully treated upon the Virginia creeper and grape by spraying with Kerosene Emulsion. Another species, *Empoa fabæ*, Harr., has been abundant and injurious upon the English Horse-beans, which are now being extensively grown by farmers for mixing with Indian corn and the seeds of sunflowers in the preparation of ensilage, according to the new Robertson combination. The horse-bean seems to be very susceptible to injury from insects. The *Empoa* above named causes the leaves to turn black and dry up. A large flea-beetle (*Systena frontalis*, Fab.) also injured this plant, among several others, by eating the soft tissues of the upper surface of the leaves. The common Red-legged Locust was even more injurious in the same way, and in the North-West Territories, the large and beautiful Western Blister-beetle (*Cantharis Nuttalli*, Say) entirely defoliated patches of these beans. The sunflower, grown for the seeds, was not without its enemies either—early in the season Cut-worms attacked the young seedlings and later the stems of many plants were much weakened by the pith being entirely consumed by the larvæ of the beautiful Trypetid fly (*Straussia longipennis* Wied). The female is furnished with a hard ovipositor by means of which she inserts her eggs into the stems while soft and the young larvæ live in the pith. They pass the winter as pupæ in the ground and the perfect flies appear in June, when they may be found on Sunflowers and the Jerusalem Artichoke. The fly is deep honey yellow with bright green eyes and has the wings prettily mottled with brown. The season in the Ottawa district has been a particularly wet one and as a consequence some of the usually abundant injurious insects have been conspicuous by their absence. Of

Fig. 2.

these mention may be made of the Colorado Potato beetle which has been kept in check with less trouble than usual. Of course the only practical remedy is Paris Green, which meets all requirements cheaply and effectively. Several instances have been brought under my notice of the ravages of the Gray Blister-beetle (*Macrobasis unicolor*, Kirby) upon Potatoes and Horse-beans. This beetle is most frequently found in the perfect state upon the Fall Meadow Rue (*Thalictrum Cornuti*) but also occurs on other plants. In the larval condition it lives as a parasite upon the eggs of Locusts. A closely allied species with similar habits was sent in from two or three localities as a pest upon mangels, vegetables and garden Asters, of which last it destroyed the flowers.

Red Spiders have been abundant and injurious to many plants in those parts of Ontario where dry weather has prevailed, currant bushes and beans were particularly attacked. Spraying with a weak Kerosene Emulsion has been found to be one of the best remedies. On the Experimental Farm a small species of *Scymnus*, one of the Lady-bird beetles, was found to be very useful in thinning their numbers.

A stalk borer (*Hydræcia cataphracta*, Grt.) was locally troublesome in tomato fields and also occurred in several herbaceous plants, as holyhocks, sunflowers and lilies.

The root maggots of the cabbage and onion still remain troublesome pests of the market gardener. When attacking cabbages, the best results have been obtained by pouring hellebore-tea around the roots, and with onions and radishes some experiments with common salt were apparently attended with the greatest measure of success this season. These experiments will be repeated again next year.

Two of the true bugs *Lygus pratensis*, L., the Tarnished Plant-bug, (Fig. 3) and *Pæcilocapsus lineatus*, Fab. both common species, have been very abundant and injurious in some localities this year. Perhaps the most practical remedy for these is beating the infested plants over a beating net or pan containing some water, with a little coal oil on the surface. This is best done early in the morning when the insects are not so active as later in the day.

Several kinds of plant lice have been abundant in gardens. Species upon turnips, carrots, cabbages and celery having been sent in. The best remedy for these insects, where it is practicable, is to spray the plants with a kerosene emulsion, as early as possible in the season, before they have multiplied.


Fig. 3.


Fig. 4.


Fig. 5.


Fig. 6.

Of insects injurious to forest trees mention may be made of two small caterpillars which have been attacking the maples in some parts of Ontario and Quebec. The first of these *Incurvaria acerifoliella*, Hew. is a case-maker, which cuts out round disks of the maple leaf and forms a flat case, inside which it lives. In the autumn it falls to the ground and passes the winter inside its case as a pupa. The tiny steel-blue moths, with orange collars, emerge the following spring. The other is the species which has been mentioned by Mr. Fyles, possibly *Catastega aceriella*, Clem. The larva forms a tent between the two surfaces of the leaf and lives inside a tube made out of its own frass. This tube starts close to the petiole and gradually enlarges as the larva grows, until it

reaches about two inches in length. The tents were so abundant this autumn in some places that the maple trees about Knowlton and other places round Brome Lake in the Eastern Townships were much disfigured. It is also very abundant at Ottawa. I have never seen the moth yet, but have several of the larvæ and pupæ in my breeding cages, from which I hope to get the moths next spring.

Of fruit insects, some of the well known pests have called for attention, as the Eye-spotted Bud moth (*Tmetocera ocellana*, Schiff.), on the apple and plum, the Oyster-shell Bark-louse (*Mytilaspis pomorum*, Bouché), the Beautiful Wood Nymph (*Eudryas grata*, Fab.). Fig. 4 represents the moth and Fig. 5 the caterpillar. The Codling Moth (*Carpocapsa pomonella*, L.) and the Plum Curculio (*Conotrachelus nenuphar*, Hbst.). For these the well-known remedies have been recommended.

Injuries of less frequent occurrence have been reported by the following: Click beetles, which have injured the flowers of apples at Ottawa and of pears in Nova Scotia. The Shot-borer or Pin-borer (Fig. 6) (*Xyleborus dispar*, Fab.) has increased and is doing much injury to the apple-growing districts of Nova Scotia. Washing the trees in June with a soap or lime wash, to which a little Paris green has been added, will probably be found to be the best remedy. In the Niagara district I found last spring that the peach trees were much infested by the Peach-bark beetle (*Phlœotribus liminaris*, Harr.). This is a very small Scolytid and can be easily recognized by its laminate antennæ.

A new pest of the apple in Canada has been sent to me by Mr. R. Z. Rogers, of Grafton, Ont., and Mr. F. J. Watson, of Okanagan Mission, B.C., namely, the Otiorhynchid beetle *Anametis grisea*, Horn. The beetle gnaws the bark from the twigs and also eats out the buds. I have not yet worked out its life-history.

As mentioned above, the insects which have attracted most attention during the season of 1893 by their injuries are the Horn fly (*Hæmatobia serrata*, Rob.-Desv.) shown much enlarged at Fig. 7, and the three common locusts, which occur all through

Fig. 7.

Ontario. As was anticipated, the Horn-fly, since first noticed last year, has spread far and wide over the Province, and although there has been a great hue and cry amongst farmers, very few of them have systematically treated their cattle to protect them from the attacks of their tormentors. The loss consequently has been very great, owing to the falling off in the quantity of milk produced at the season of the year when it should have been most plentiful. It is not probable that the Horn-fly will continue to be as serious a pest after a year or two as it is at present in Ontario, nevertheless it is an important matter that dairymen and farmers should adopt some one of the simple and effective remedies which have been discovered and practise them regularly if they wish to keep their stock in a state of comfort and prevent an unnecessary shortage in their bank accounts. In the first place

it is necessary to remember that the Horn-fly does not in any case breed (that is, pass its preliminary stages) on or in the cattle; but the eggs are laid on freshly dropped cow dung; the young maggots hatch within 24 hours and live until full grown in the moist excrement; this takes about a week; they then burrow down a short distance into the ground and assume the pupal form, from which, in about another week, in summer, the perfect flies issue. The last brood of autumn passes the winter beneath the ground within the puparia. The flies are extremely active and swarm on cattle, biting them and giving them much annoyance from the irritation of their bites. The name Horn fly is applied to this insect from its habit of clustering upon the horns of cattle. Here they are out of the reach of the animal's tail and are not easily dislodged. They do no injury whatever to the horns.

Remedies. The remedies are simple, but require constant attention to be effective. Almost any greasy substance rubbed over the parts of the animal usually attacked will prevent the flies from biting for two or three days. For this purpose "tanners' oil" or any other cheap fish oil is satisfactory, and if a small quantity of carbolised oil, which can be prepared in a short time by any druggist, be added, the effect will be more lasting and the application will have a healing effect upon any sore which may have been made by the animal rubbing or licking itself. An easily applied remedy, which has been found effective by most who have tried it, is the kerosene emulsion, which is practically a mixture of soapsuds and coal oil in the proportion of two of coal oil to one of soapsuds. To make the emulsion, boil half a pound of any common hard soap in one gallon of water; when all is dissolved, and while boiling hot, pour it into a large tub containing two gallons of coal oil, then churn this well with a syringe or force-pump for five minutes, when the mixture will be smooth like cream. This emulsion cools into a jelly-like mass, and may be kept for any length of time if placed in a cool cellar. When required for use, it may be diluted with cold water to the strength required. One part of the emulsion to nine of water works well. It is easily applied to the animals by means of a force pump and spray nozzle. While the flies are bad, it should be applied every other day for a fortnight; after that the odour of the accumulated coal oil will keep them off for a longer time. There certainly is a good deal of work about this application which farmers may object to, but so long as the flies are as numerous as at present, it will be necessary to take these extra precautions if they wish to protect their cattle and their own interests. It is well to mention, however, that in all the districts in the United States where three or four years ago this insect was extremely abundant, it has decreased greatly in numbers, and there is every reason to anticipate that this will be the case here too.

Throughout all the western portions of the Province a large amount of loss has been caused by locusts. All the specimens sent to me have belonged to three different species, which are always common, viz., the Red-legged Locust (*Melanoplus femur-rubrum*, DeG.) Fig. 8. The Lesser Migratory Locust (*Melanoplus atlanis*, Riley) and the Two-striped Locust (*Melanoplus bivittatus*, Say.). The Red-legged Locust has a very wide range and is common in all parts of the country. It attacks all kinds of vegetation, and has a particularly bad habit, which has been much noticed this year, of biting off the heads of oats just before they ripen. The Lesser Migratory Locust resembles the last named very much. It is, as a rule, rather larger and brighter in colour. It has longer wings and can always be separated from it by the sharply-pointed sternum or breast-bone, that of *femur-rubrum* being spatulate or enlarged at the apex. This species is migratory in its habits, like the Rocky Mountain Locust, and frequently is the cause of great injuries to crops, not only in the North-west, but in Ontario and New England; in fact, Prof. Bruner credits it with being the species which most frequently does the locust injury in the New England States.

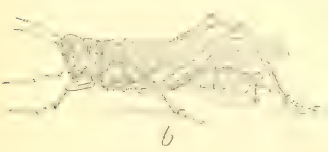

Fig. 8.

The Two-striped Locust is a large, heavy-bodied and voracious species, which destroys a great amount of vegetation. It generally frequents rank growing plants in low ground, but as often occurs in gardens, where it is very troublesome.

Locusts are, as a rule, kept within due limits by their many enemies, but occasionally they appear in large numbers and increase so much as to cause locust plagues or "grasshopper years." This is generally in dry summers, when they get the conditions which are most advantageous for their development, but which are adverse to the free growth of vegetation. In such years it is necessary to have recourse to artificial means to protect crops. The most successful of these have been the plowing under deeply of the eggs, which have been known to have been deposited in certain localities, before they have time to hatch, and the use of the tar-pan or "hopper-dozer," by means of which the insects are caught in large numbers and destroyed before they have developed their wings. These tar-pans are large, shallow pans, made of sheet iron after various patterns, but, as a rule, about twelve feet long by three wide, with the edge turned up slightly in front and the back about eighteen inches high. In the bottom of these pans a small quantity of tar or coal oil is placed and they are then drawn over the fields by horses. The grasshoppers spring in the air when the pan is drawn towards them and fall inside the pan, where they come in contact with the tar or oil, and even if they hop out again they are sure to die. In this way enormous quantities are destroyed every year in the Western States.

A vote of thanks to Mr. FLETCHER, for his valuable and highly interesting address, was moved by Rev. T. W. FYLES, who remarked, in doing so, upon the occurrence at Quebec of both the species, *Orgyia leucostigma* and *nova*. Dr. BETHUNE cordially seconded the motion and expressed the great pleasure that all present had experienced in listening to the address. In the course of his remarks he referred to the unusual abundance this year of the Tomato-worm, the larvæ of *Sphinx quinque maculata*, and of several species of grasshoppers and to the entire absence in his garden of the Pear-tree slug, which had been very abundant and injurious for several years previously. He stated that a friend, resident in Toronto, was of opinion that the number of house flies had been very greatly diminished by the English sparrow, which devoured the larvæ, and enquired whether this observation was correct. He spoke also of the publication of a bibliographical catalogue of the Noctuidæ of North America, by Prof. J. B. SMITH, as one of the notable events of the year.

Mr. DENTON, in putting the motion to the meeting, spoke of the value of the remedies for the Horn fly, and gave instances of herds of cattle being kept in splendid condition by being protected from the attack of this annoying insect.

The reports of the different sections for the past year were next read by their respective secretaries.

ANNUAL REPORT OF THE ORNITHOLOGICAL SECTION OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO FOR 1892-3.

This section has held about half a dozen meetings during the year, most of which have been attended by almost every member. The approach of the collecting season, however, led to such a scant attendance that the meetings were dropped.

A ledger was opened to record the distribution, abundance, nesting habits, etc., of the birds of Middlesex and surrounding counties, on which several evenings' work was done before the cessation of meetings, and it is the intention of members to push it to completion, if possible, during the coming season.

Each member of the section has been devoting himself to the special study of one bird, and the hawk family has thus been divided between the members for report this present fall. Good results are looked for from this concentration of work.

No very rare birds were observed during the season, but the Olive-sided Flycatcher and the Fox-colored Sparrow were observed to justify the opinion of their increased local abundance, while the Tennessee warbler was unusually common for a few days in spring, and was singing freely, a habit which was not previously noted in our locality. All of which is respectfully submitted.

W. E. SAUNDERS, Chairman.
W. J. STEVENSON, Secretary.

REPORT OF BOTANICAL SECTION OF ENTOMOLOGICAL SOCIETY.

The Botanical Section held their first meeting for 1893 on April 29th, and from then till July 1st, weekly meetings were regularly held. The attendance at the meetings and the interest shown have been greater than in previous years. A careful list of the plants observed by members, their localities and dates of blossoming, has been made out. Outings to Port Stanley and to Komoka were very interesting and fruitful.

A large portion of the collection presented to the Section by Wm. Scott, B.A., of Ottawa, has been mounted by Mr. Balkwill, and the work will probably be completed during the ensuing winter. Our herbarium is increasing and we hope to make it thoroughly representative of the district.

Observations worthy, perhaps, of mention are the finding of *Moneses uniflora* and *Hypoxys erecta*, growing plentifully at Komoka, these being the first records for that district for some years at least. *Hedeoma Drummondi*, not mentioned by Macoun, and in late editions of Gray said to extend from Ohio southward to Texas, was also found near Komoka. A remarkable case of fecundity of the Beech is reported by Mr. Balkwill, who finds the cupules containing as many as six nuts each. Mr. Moffat found several specimens of *Aphyllon uniflorum* growing near the city, not before reported nearer than Port Stanley.

W. T. McClement, Secretary.

REPORT OF THE MICROSCOPICAL SECTION OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

I have much pleasure in placing before you the annual report of our Section. It is now three years since this section was organized, and we can look back with pleasure on the work of the past few years.

Thirteen meetings were held during the season which has just closed, from October 22, 1892, to May 19, 1893, when our section adjourned during the summer months. Our total membership numbers fourteen, an increase of fourteen per cent. since last year, with an average attendance of (13) thirteen, an increase of 45 per cent. over last year, which shows the interest the members are taking in this part of the work.

The work undertaken by the Section has been of a very practical and useful character. Members have been thoroughly drilled in the cutting of sections, staining and mounting them. During the past year we have had several outings, when the manner of collecting material has been practically demonstrated, and we feel confident that this method of work adopted by our Society will make our members skillful in microscopical manipulation and will also acquaint them with all the uses a microscope can be put to.

Several new microscopical (fungi) plants have been added to the list and their life history worked out.

We are deeply grateful to the parent Society for the very liberal manner in which they have supplied us with periodicals and the great encouragement they have given our Section. We are sure that in return the Section will become a valuable adjunct to the Society.

The subjects for the various meetings during the season were as follows:

Oct. 22nd, 1892: Open meeting. Examination of pond water. Discussion as to arrangement of meetings for the term. Each member is assigned a subject which he is expected to work up as far as possible and then report on it.—J. M. Denton, Chairman.

Nov. 6th: Study of Desmids, by J. H. Bowman. Closterium and many others exhibited and described.

Nov. 20th: Open meeting.

Jan. 6th, 1893: Reports of outings during Christmas holidays. Business meeting.—J. M. Denton, Chairman.

Jan. 20th: (1) Clothes moths, by J. DEARNESS. An article by JAMES FLETCHER was quoted upon clothes moths, Tineola Biselliella, from 23rd Annual Report, page 53. Samples of fabric damaged by this insect were examined.

(2) Desmids. 1st, how to collect; 2nd, where to collect: 3rd, what to collect, either as useful, beautiful or scientific objects, by J. H. BOWMAN.

Feb. 3rd: Study of urinary deposits and what they signify, by Dr. J. P. BURKHOLDER.

Feb. 20th: Two lectures were delivered by Dr. J. P. BURKHOLDER on the Mounting of Animal Tissue and Preparation and Staining.

March 3rd: Mounting of Animal Tissue continued. The use of the microtome, by Dr. J. P. BURKHOLDER.

Several very interesting sections were prepared and mounted under the lecturer's instructions.

April 7th: Three lectures were delivered on Vegetable Tissue, by J. DEARNESS. Preparation of Vegetable Tissue.

April 21st: Staining of Vegetable Tissue, by J. DEARNESS.

When is double staining necessary? Alum cochineal as a stain. Picro lithium carmine as a stain. Several specimens of ferns were stained.

May 5th: The mounting of Vegetable Tissue, by J. DEARNESS.

The several specimens of ferns which were stained last evening were mounted.

May 19th: Report on the Examination of Dawson's Pond, by J. H. BOWMAN, A microscopical exchange was arranged with A. ALLEN, of London, Eng.

All information as to the Society's microscopes, books and mounts, the number of members owning microscopes, will be found in "The Microscope," page 38, vol. 1, No. 3. (Washington, March, 1893.)

All which is respectfully submitted.

H. A. STEVENSON, Secretary.

REPORT OF THE GEOLOGICAL SECTION.

With regard to the work accomplished by this section of the Society: The surrounding district of London has been searched wherever an outcrop of the base rock could be found exposed from the overlying lacustrine and boulder drift. The bed of both forks of the river Thames as far as Dorchester and St. Marys in one direction, and Kilworth and Komoka in the other, including a very good exposure of the quarries at Springbank, as also some miles of the river midway, were searched and found to yield many good specimens of Phalops, Bufo, Strophomena, Spirifers, Stricklandia, Orthis, Spirigera and a very peculiar specimen of the squid tribe, possibly an Omioceras. Some of the members have extended their researches further afield, and in the gorge of the Grand River at Elora and Galt have unearthed Phragmoceras, Oncoceras, Megalomus Canadensis, Lituiter, Bellerophon—a fine specimen of the last was obtained from the cliff above Wiarton. The Rev. C. H. Andras, who has lately joined the society and has proved a very active member, has added very much to the knowledge of the fossils and minerals of this portion of Ontario and has visited also the mineral regions north of Lake Huron, discovering traces of gold in a blue quartz matrix in various districts along a line of 200 miles following the route of the C. P. R., specimens of which, as well as those of the copper, nickel and silver of these districts of mineral wealth have been exhibited to the society and now form a portion of the private collection of the professor at Huron College.

During the year a report appeared in the local press that coal had been discovered in the Lambton formation at Kettle Point. To verify this the chairman (Dr. Woolverton) accompanied by Profs. Andras and Sherwood, visited the district in question and found thin bands of bituminous coal in the Devonian shale which crop out at this point. It is questionable, however, whether workable coal could be obtained here, for a few miles

south of this—at Ilderton—a boring was made through this shale formation which proved only natural gas in a small quantity and upon being continued deeper, a bed of salt was reached which is now being worked—the salt works being lit by the gas thus obtained. Perhaps the most remarkable objects in the vicinity of Kettle Point are the globular concretions of semi-crystalline limestone, ranging in diameter from two to six feet and of an internal radical structure and bituminous in nature. Several specimens were obtained and brought home by the party. In all these expeditions the local collections have been visited and their cabinets overhauled and exchanges made of duplicates. An interesting point to Geologists is Thedford and its vicinity—the railway cutting close by abounds in specimens of spirifers, orthoceras and fossil corals in great abundance, Favosites Cyathophyllum and Helliolites Halli. A fine collection of the local fossils has been made by the Rev. Mr. Currie, the Presbyterian pastor. A great need of geological maps of the peninsula has been felt to enable this society to carry on its work more thoroughly and profitably. The library on the other hand is well supplied with Geological literature which this section highly appreciates, but would gladly welcome any additions of more recent publications as they appear. The want of room greatly contracts the possibilities of the society. It has now been felt, and the feeling is widely expressed, that the time has arrived for the society as a whole to obtain more commodious premises, in order that not only the parent Society should have more room for the display of its own fine collections of insects (at present by no means shown to advantage owing to the difficulty of access by three flights of stairs and the crowded condition in which they are arranged), but also that the sub-sections might each have the opportunity of making a display of its collections. This branch at least feels that from its progress and increase of numbers this is worthy of the consideration of the parent Society. We have the honor to submit to this Society the foregoing as our report for the year past.

S. Woolverton, Chairman.

ELECTION OF OFFICERS.

The following gentlemen were elected officers for the ensuing year :

President—W. Hague Harrington, Ottawa.

Vice-President—J. Dearness, London.

Secretary—W. E. Saunders, London.

Treasurer—J. A. Balkwill, London.

Directors—Division 1—James Fletcher, F.L.S., F.R.S.C., Ottawa.
" 2—Rev. C. J. S. Bethune, F.R.S.C., Port Hope.
" 3—Gamble Geddes, Toronto.
" 4—A. H. Kilman, Ridgeway.
" 5—R. W. Rennie, London.

Librarian and Curator—J. Alston Moffat, London.

Editor of the "Canadian Entomologist"—Rev. C. J. S. Bethune, M.A., D.C.L., Port Hope.

Editing Committee—J. Fletcher, Ottawa ; H. H. Lyman, Montreal ; Rev. T. W. Fyles, South Quebec ; J. M. Denton and J. H. Bowman, London.

Delegate to the Royal Society—Rev. T. W. Fyles, South Quebec.

Committee on Field Days—Dr. Woolverton, Messrs. McClement, Elliott and Stevenson, London, and one representative from each section.

Auditors—J. H. Bowman and J. M. Denton, London.

A paper was then read by the Rev. T. W. Fyles on "Entomological Mistakes of Authors," which was highly enjoyed and appreciated by all present.

Mr. Fletcher drew attention to one point in the report of the Ornithological section viz., the success achieved by devoting observations to one bird alone, and urged that this principle should be adopted by Entomologists, so that each one might work out the life-history of some particular insect.

The meeting adjourned at 10.30 p.m.

THURSDAY—MORNING SESSION.

The meeting was called to order by the Vice-President at 10 o'clock a.m.

A paper by Mr. A. H. KILMAN, of Ridgeway, was read on a supplementary list of Coleoptera not previously recorded as taken in Canada This paper, being of a technical character, will be published in the *Canadian Entomologist.*

Dr. BETHUNE read an extract from a newspaper, which stated that farmers in England were much alarmed because dead insects, especially grasshoppers, had been found in numbers in the recent large importations of hay from Canada. The purchasers feared that the animals fed upon the hay might receive injury from consuming the insects, and the farmers were afraid that through the importation of the bodies of the insects the eggs of the locust might be introduced into England, and a locust plague be occasioned in the country. The despatch went on to state that " Miss Eleanor A. Ormerod, the great insect authority of England, the consulting entomologist of the Royal Agricultural Society of England, and special lecturer on economic entomology at the Royal Agricultural College of Cirencester, and who is also the English corresponding member of the Entomological Society of Ontario, has published very reassuring statements, which are calculated to allay all alarm. She says that it is unlikely that locusts will propagate in Great Britain, owing to the comparatively moist and cool climate. She also declares that there is no evidence whatever that locusts are at all prejudicial to the health of cattle that eat them." Dr. Bethune gave it as his opinion that the fears of the English farmers respecting the importation of our locusts were perfectly groundless, and there was no likelihood of eggs being hatched and colonies established from the dead insects carried over in bales of pressed hay.

The remainder of the morning was spent in the examination and determination of specimens, many rare and interesting forms having been brought to the meeting by Mr. Fyles, Dr. Bethune and some of the local members. After comparing notes on various matters of entomological interest, the meeting, which was greatly enjoyed by those who were present, was brought to a close. Much regret was expressed by all at the absence of the President, whose address will be found in the following pages. The members from a distance were much gratified at the kindness and hospitality rendered them and desire to record their hearty thanks to their kind entertainers.

ANNUAL ADDRESS OF THE PRESIDENT.

BY W. HAGUE HARRINGTON, OTTAWA.

While the earlier incumbents of an office, such as I have had this year the honor to hold, are fortunate in finding new lands through which to wander and from which to garner fresh crops, those who come in later years have, at least, well laid-out fields to till and good plain paths to follow. As the President's address is published in the Annual Report which our Society prepares for the Ontario Department of Agriculture, and as the address is often his only contribution to the Report, it becomes almost imperative that it should be of as economic and practical a character as possible, and at the same time be worded, in such a clear and simple manner, that it may be readily understood, not only by the members of our own society, but by the larger audience reached by the Report. Instead, therefore, of endeavoring to treat technically, or elaborately, of any of the many special branches of Entomology, I shall keep in the well defined paths which my predecessors in office have laid out.

A city residence and official duties, which for several weeks in midsummer prevent any observations, combine to cause my work in Entomology to lack the continuity which is necessary for a thorough investigation into the life-histories of our insect foes and friends. The assistance of fellow-workers enables me, however, to say a few words about some of the more noticeable insects of the past season. Of these I shall first mention

several species of saw-flies, as I have endeavored to give somewhat special attention to the extensive and injurious section of phytophagous (plant-eating) Hymenoptera, to which these insects belong. I have not yet had time to catalogue all the species recorded from Canada, but I find that we have in the immediate neighborhood of Ottawa about one hundred and sixty species, of which several are decidedly obnoxious pests. Saw-flies are so named because the female has the ovipositor saw-like in form, and fitted to cut a slit in the leaf or twig in which she desires to deposit her egg. The worm hatched from this egg is not a footless maggot, such as that of the other sections of the Hymenoptera, but is provided with both thoracic and abdominal feet, is able to travel about in search of fresh food, and has much resemblance to the caterpillars of certain moths. The worms feed upon the tissues of the leaves, and, when numerous, soon strip the plants attacked. A good example of the ordinary saw-fly larva is the worm that is so troublesome on gooseberry and currant bushes, when they are not carefully sprinkled with hellebore.

The Larch Saw-fly (*Nematus Erichsonii*, Hartig.)

It would be almost impossible to calculate, and very difficult even to imagine, the enormous loss occasioned in the tamarack forests of Canada, during the past decade, by the inconspicuous insect which has become known to Entomologists as the Saw-fly of the Larch. The first mention of it in the Annual Reports of the Entomological Society of Ontario is found in that for the year 1883 (No. XIV., page 17) where, in the account of the proceedings of the Annual Meeting, the Rev. Mr. Fyles, of Quebec, is reported as stating: "That much injury had been caused to the tamarack trees, *Larix Americana,* in Bury and the neighboring townships, by a species of saw-fly, the same, probably, as that which has caused so much injury in Maine and the other eastern States, *Nematus Erichsonii.*"

The following year the same gentleman reported that: "The larch saw-fly had extended it ravages along the Beauce Valley to the neighborhood of Quebec, where it had stripped the tamaracks bare. A second growth of leaves had appeared, and this, probably, would save the trees."

Mr. Fletcher also spoke of the "enormous damage" done by this insect. He had first noticed it near Quebec, and had traced it down the Intercolonial Railway wherever any larch trees occurred, as far as Dalhousie (N.B.), where he found it abundant. He also exhibited a species of bug, *Podisus modestus*, which had been found destroying the larvæ at Brome, Que. (Ann. Rept. No. XV., p. 22.) The same Report (pages 72-77) contains a carefully prepared paper by Mr. Fletcher, on the habits and appearance of the insect.

In 1885 (Ann. Rept. No. XVI., page 12), Rev. Mr. Fyles reported: "That the insect had again been abundant at Quebec, and that tamaracks that had survived the attack of last year, now showed tokens of decay, some of the branches only putting forth a second crop of leaves, and that but a sparse one." He described the manner in which one of the fossorial wasps, *Odynerus capra*, had been observed to prey upon the larvæ. At the same meeting in "Some Notes on Tenthredinidæ, 1885," (Canadian Entomologist, Vol. XVIII., page 39), I mentioned the finding, at Ottawa on 24th June, of several colonies of the larvæ of this saw-fly upon trees near the line of the Canada Atlantic Railway.

Mr. John G. Jack, of Chateauguay, Que., in a paper read before the Montreal Branch on 9th Feb., 1886, records (Ann. Rept. XVII., page 16,) the occurrence of the destroying insects in his neighborhood as follows: "On July 5th I found some larch trees with the foliage very much destroyed by saw-fly larvæ, and on examining the trees in the woods and surrounding country, I found that they were all attacked. At this time most of the larvæ seemed to be a little more than half-grown, and they continued to feed until about July 15th, when some of them made cocoons. Many of the trees were now entirely defoliated, and the branches and twigs literally covered with the larvæ, many of which were dropping to the ground, and with the falling 'frass' made a sound like fast falling raindrops."

Prof. Saunders, at the Entomological Club of the A.A.A.S., in 1887, reported, "that in the Maritime Provinces, Nova Scotia and New Brunswick, he found the larch saw-fly (*Nematus Erichsonii*), extremely abundant and destructive." (Ann. Rept. XVIII., page 31.)

Mr. Fletcher, in his address as President in 1889, made the following brief reference to the spread of this pest: "The larch saw-fly was very abundant in the neighborhood of Ottawa, and in fresh districts in the Maritime Provinces; the tamarack swamps being rendered almost leafless for hundreds of acres." (Ann. Rept. XX., page 3.)

The Rev. Dr. Bethune, in his address the following year, referred to the species briefly: "The larch saw-fly, to which reference has been made of late years, has not been nearly so abundant as usual in those parts of Ontario where it has hitherto prevailed. It is to be hoped that its natural enemies have multiplied to a sufficient extent to keep it in subjection and prevent its undue increase." (Ann. Rept. XXI., page 7.) In 1891 he again stated that it "continues to be very abundant and destructive. Unfortunately it is a kind of attack for which there seems no practicable remedy." (Ann. Rept. XXII., page 14.) At this meeting also the Rev. Mr. Fyles presented a valuable paper entitled, "*Nematus Erichsonii*; a Retrospect" (l. c. page 28,) to which reference will be made presently.

I have now traced the progress of this obnoxious insect, as recorded in the publications of our society, but a few remarks may be added on its later ravages, and the extent to which it may have permanently injured the tamarack areas of the Dominion. While we have seen that as early as 1883 it had spread through Quebec, it is probable that it had been in Canada at least a year or two previously, but had only then reached a locality where it came under the notice of an entomologist.

My own observations along the line of the Intercolonial Railway and the Maritime Provinces, during the period elapsed since the insect was first reported, fully confirm the extent of the injury wrought in the tamarack districts, and the extent to which the trees were killed. Up to 1890, however, the insect had not, as far as I could see, invaded the Island of Cape Breton, but in the autumn of that year I found, not many miles from old historic Louisburg, a single twig with the characteristic twist and the evidence of oviposition, showing that the enemy had crossed the island. I did not find other evidences of its presence, and all the surrounding trees looked most healthy and vigorous. The worms were in this year reported as very abundant in Prince Edward Island.

The next year I did not visit Cape Breton, but in the beginning of September, 1892, just after our annual meeting of that year, I was in Sydney, and, on driving out through the surrounding country, found that the beautiful green tamarack groves and forests, which (with spruce) are in this section of country quite extensive, had the fire-swept appearance caused by the ravages of the saw-fly, and I was informed that in the previous summer they had been almost as much defoliated. The lower portions of many trees, and small trees had, as elsewhere, partially escaped, but many of the larger trees seemed to be killed. This year the same dreary appearance was observed, and there is no doubt that very serious loss of older trees has been caused.

Whence came the obnoxious insect which has so devastated and disfigured our beautiful woods and by what route did it invade our territories? Apparently from Europe, whence have come many of our most injurious insects, and, unfortunately, but few beneficial ones, and probably through the New England States. The first record that I can find of its appearance in the New World is contained in one of Dr. Hagen's "Entomological Notes", (Can. Ent. Vol. XIII., page 37), where he identifies specimens of larvæ, received from Harvard Arboretum in 1880, as agreeing perfectly with the description and figure of *Nematus Erichsonii*. These larvæ, it may be added, had been discovered feeding on European larches, and at first the native larches appear to have escaped.

In Maine in 1882 the spread of the insect was very extensive, and in the same year it occurred in Massachusetts, New Hampshire, and New York, proving that the insects had multiplied and spread with most astonishing rapidity. The United States Entomological Commission made examinations, in this and following years, of the infected districts, and in its very valuable Report on Insects Injurious to Forest and Shade Trees (1890), Dr. Packard gives a full account of the insect and its ravages. In his Report for

1884, he summed up the condition of the larches as follows, and he thinks that the prediction therein contained, was almost verified in 1885: "On the whole, then, while a small proportion of larches have been killed by this worm, this vigorous tree, though defoliated for two successive summers, seems, in the majority of ca es, to survive the loss of its leaves, though it threw out much shorter ones the present summer. Possibly 10 per cent. of our northern larches died from the attacks of this worm. Very probably the numbers of this insect will diminish during the next year, and the species may ultimately become as rare as it has always been in Europe."

The maximum of damage having been committed, and the supply of food having been correspondingly diminished, have probably led to an arrest in the further development of the insects, and their numbers may continue to decrease. It will be, however, many years before the districts ravaged by them regain their wonted luxuriance of vegetation, and the larch forests which they have destroyed will in many instances be replaced by spruces (Maritime Provinces) cedar (Quebec) or other trees which may find the vacated localities suitable for their propagation.

In the paper by the Rev. Mr. Fyles, already mentioned, he gives some figures to show the amount of injury done in the one Township of Bury, in the County of Lennox, Quebec, and an application of these estimates for one square mile, to the extended areas of trees destroyed in the several Provinces, will give some idea of the actual money value of the damages inflicted upon our possessions by this unwelcomed immigrant. "As we have seen, there are in Bury 640 acres of tamarack, giving on an average forty marketable trees to the acre, or 25,600 such trees in all. Every tree contains at least 400 feet, board measure, of lumber. This gives for the whole forest 10,240,000 feet, which, in a sound condition, would have been worth $30,720," at $3 per 1,000 feet on the stump, "and which left standing, would, under favorable circumstances, have been increased in value." He places the total loss to the township at $50,000, and to the adjoining Township of Lingwick at double that sum, and in consideration of the wide extent of the insect's depredations, he comes to the conclusion that "*Nematus Erichsonii* has been the worst insect pest that has ever visited the Province of Quebec." Regarding the re-growth of the trees, he adds: "The tamarack forest of the Townships is a thing of the past. There seems to be a law of nature, that, when one growth of trees is swept away, another of a different kind shall succeed it. The hemlocks and pines of our mountain sides give place to the poplar and the white birch. The tamaracks will probably be succeeded by the American arbor-vitæ, or white cedar (*Thuja occidentalis.*) And, if there were no such natural law, the world is too old, its population too vast, and land in the temperate regions too valuable, for us to suppose that large tracks of lowlands will be left in a state of nature for 200 years to come."

Although this insect has probably come to us from Europe, it is not there the same prolific pest which it has become under the stimulus of our more extensive tamarack forests, a change of climate, and, perhaps, escape from hereditary parasitic foes. It was described and named in 1838, and Cameron gives its continental distribution as Sweden, Denmark, Prussia, Holstein, Harz, Bohemia. Holland and France. The only country in which it is reported as injurious is Germany. In Great Britain "it does not not seem to be a common species. I have only seen a specimen taken by the Rev. T. A. Marshall, of which I do not know the locality. Mr. Dale records it from Glanville's Wootton." Its parasites are given as *Perilissus filicornis* and *Pteromalus Klugii*, Rtz. The former genus has not been recorded from America, but the latter species may possibly be identical with the parasite of which D. Packard bred considerable numbers in 1882, and to which he gave the provisional name of *P. nematicida.*

For descriptions of the insect and further information as to its habits, reference can be made to the excellent paper by Mr. Fletcher in Ann. Rept. No. XV. Cameron states that the male is unknown, and from all the larvæ we have bred there has not emerged a single male. I have, however, one male, taken in a tamarack swamp on the 15th June, 1889, which seems to belong to this species, differing from the female chiefly in having the antennæ, except two basal joints, and posterior legs almost rufous, and the sides of prothorax almost white.

Rose Saw-flies.

A new saw-fly made its appearance this year upon my roses, so that there are now three species attacking these favorite plants. One of these has been known for many years to the lovers of the rose as a troublesome pest, which rapidly destroys the foliage if not promptly looked after. This is *Monostegia rosæ*, Harris, described in 1841 and then placed in the genus Selandria, which has since been sub-divided. Although named in America there is very little doubt that it came from Europe, where it is well known as a troublesome insect, and where several names have been subsequently bestowed upon it. The small stout black flies are abundant in May and June, and the eggs are deposited in the under surface of the leaf, generally near the edge.* The slug-like larvæ feed, at night, upon the upper surface of the leaf and cause it to become brown and withered. In about a fortnight they are fully grown and drop to the ground in which they construct an earthern cell to shelter them until they pupate and emerge the following May or June. There appear to be but two mentions of this saw-fly in our reports: The first by Mr. Gott, of Arkona, in 1878 (Ann. Rept. No. IX, page 57), who stated that it was becoming very abundant and troublesome; the second in my paper on Saw-flies (Ann. Rept. XV, page 70) where its habits are concisely stated.

The second of our pests has not been long known to us, as such, but probably it crossed the ocean many years since, as it was named by Harris about fifty years ago as a new species. This insect is called *Cladius pectinicornis*, Fourc., (*C. isomera*, Harris), and its larva may be called the Bristly Rose-worm to distinguish it from that of the previous species. Dr. Riley, in an interesting article on "Rose Saw-flies in the United States," records this species as first discovered on his rose-bushes (Washington) in 1880 (Insect Life, vol. V, page 7), and it is also several years since I first bred the insect from larvæ taken on a rose-bush in Ottawa, although I cannot find a record of the exact date. I have since bred the species on two or three occasions, and find that it is becoming more abundant. In 1891 I took a specimen at the High Falls on the Des Lievres about 50 miles from the city. The species is apparently double-brooded here (in Washington three-brooded) as the flies appear from May to July. The eggs are laid in the leaf-petioles and hatch in a few days. The larva feeds on the under surface of the leaf, remaining concealed there, and at first making small holes; but these holes increase in size and number with the rapid growth of the grub, and in a few days nothing will remain but the midrib and some of the stronger laterals. The larva is greenish, with an almost orange head and with rows of small warts from which rise rather stiff bristles or hairs.† When fully grown a delicate thin cocoon, with a more or less complete outer one, is spun upon the under side of the leaves or branches, or in rubbish upon the ground. The pupal state of the first brood lasts about a fortnight, but the second brood passes the winter in this form. The flies are considerably larger than those of *M. rosæ* and have the legs and wings paler.

The third species, which has been noticed here for the first time this year, is *Emphytus cinctus*, Linn., of which the larva may be distinguished as the curled Rose-worm, from its position when at rest. This is also a well-known European species, which received a new name (*cinctipes*) from Norton in 1867. This species was first reported as a rose-pest in America by Mr. John G. Jack, who found it very injurious in Boston and Cambridge in 1887 and following years. The eggs are laid singly on the under side of the leaf, but there may be several on a single leaf. The larvæ are smooth cylindrical worms, somewhat stouter toward the head, (which is tawny with a black patch on vertex) and are greenish or yellowish-green above and whitish below. They feed on the edges of the leaves until these are consumed, and when at rest are coiled spirally beneath a leaf, or on the stripped stems. When fully grown they are said to generally pupate in the rose-branches, or in rotten wood or pith. Those that I bred this summer, however, buried in the ground in preference to using the pieces of corn pith which I had provided for them. There are probably two or more broods of this species here, as in the United States and

*Cameron states of the European insects that, "The eggs are laid in the midrib in May," and that, "The small oval cocoons are spun in the earth."

†It may be mentioned here that the description given by Dr. Riley does not quite agree with that given by Cameron of British larvæ.

Europe, although I only observed one this year. The worms of this brood finished feeding about the end of June, and the flies (of which I obtained five females and one male) emerged at different dates during July. The flies are about the same size as the preceding species, but may be readily distinguished from them by the banded legs, while the females have also a white band across the abdomen. Although the larvæ were noticed this year for the first time, it may be stated that Mr. Fletcher gave me last winter a male, which had been previously captured by him.

While these three species of saw-flies are troublesome and rapidly defoliate neglected plants, they can be quite easily destroyed and kept in check, by a careful spraying at necessary intervals during the season, with a solution of hellebore made by using an ounce of the drug to a gallon of water.

The Pear tree Slug, *Eriocampa* (*Selandria*) *cerasi*, Peck.

Slug-like larvæ apparently identical with those which have been mentioned in previous Reports, (Nos. V, VI, IX, etc.) as attacking pear and cherry trees, were this year very abundant at Ottawa upon Mountain Ash and Cratægus. This worm, Fig. 9, is, when young almost black, or appears so on account of a slimy secretion with which it is covered; the front portion of the body is much enlarged, and the head thereby almost concealed. When fully grown it is almost half an inch long, and after the final moult the color is yellow and the skin is free from slime. There are altogether five moults; the cast off slimy skins adhering to the leaves. The insect feeds upon the upper surface of the leaf, causing at first a small whitish patch, but as the epidermis of the leaf is devoured more and more rapidly with the enlargement of the worm, the foliage of a badly infested tree soon has a dark withered appearance and commences to drop off. Pupation takes place in the ground, in cells lined with a sticky substance, which forms a species of earth-encased cocoon. The species is double brooded; the flies of the first brood emerging about a fortnight or three weeks after the larvæ bury; those of the second not appearing until the following spring. The larvæ were noticed in the summer of 1892, but were much more abundant this year, and greatly disfigured some of the ornamental trees in the city. The attack was most severe upon the variety known as Oak-leaved Mountain Ash (*Pyrus acuparia* var. *quercifolia*) the American form suffering comparatively little. The ravages of this saw-fly, Fig. 10, may be easily checked by spraying either with hellebore or paris green. Although the larvæ were so abundant I have not been able to recognize a single specimen of the fly among my captures, and specimens which I was breeding this summer of the first brood emerged during my absence from home and were so badly moulded as to be unrecognizable.

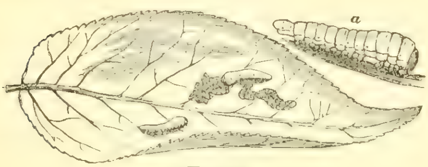

Fig. 9.

Fig. 10.

The Cornel Saw-Fly, *Harpiphorus tarsatus*, Say.

In *Insect Life* (Vol. II, page 239-243) is an article on "The Dogwood Saw-fly," which supplements a paper which had been contributed to *Garden and Forest* by Mr. J. G. Jack under the title "A Destructive Cornel Saw-fly (*Harpiphorus varianus*, Norton)." As this insect is also found to attack Cornel in Canada a brief mention of it may not be out of place. But before noting its operations I would like to point out that my observations go to show, as I have already indicated (*Can. Ent.* vol. XXV, page 59) that *H. varianus*, Norton, is only a paler form of the species described by Say in 1835 (Le Conte Ed., vol. II, page 679) from Indiana, under the name *Emphytus tarsatus*. *H. versicolor*, Norton, and *H. testaceus* of same author are also apparently forms of the same insect, which is variable in colour. The proper name for the species would, therefore, appear to be *Harpiphorus tarsatus*, Say, with *varianus*, *versicolor* and *testaceus* of Norton as variations, and it may perhaps be better to call it the Cornel Saw-fly, as in some portions of Canada the name Dogwood is not always confined to these shrubs. The flies appear at Ottawa in June and the early part

of July, and the eggs are then laid in the upper surface of the leaves, the larvæ, when hatched, emerging on the under surface, where they rest coiled up out of sight. During the earlier stages the larva is covered with a white bloom, or efflorescence, which is very easily removed. The head is black, and the feet and under portions yellow. When the last moult takes place the appearance of the larva is greatly changed; it becomes of a bright yellow with rows of black spots along the back and sides, and is no longer covered by the white powdery excretion. Pupation takes place in burrows bored in dead branches, pithy stems, decaying wood, etc., a habit which in some localities is evidently a preservative one, as the land may be flooded for a considerable time in the spring, and if pupation took place in the ground many of the insects would probably perish. The native species of Cornel upon which I have observed them is *Cornus stolinifera*, but at the Experimental Farm they have this year been abundant enough upon *C. sibirica* to be quite injurious. Mr. Fletcher, who has been rearing a number of larvæ from these shrubs informs me that two species seem to be indicated, one being much larger and somewhat different in markings from the other, but until the flies emerge next season this cannot be decided. Under date of 7th Aug., Miss Rye, of Niagara, writes to Mr. Fletcher that the previous week these larvæ had appeared upon her ornamental dogwood trees in immense numbers and had greatly injured them. Upon ornamental plants, however, the depredations of this insect may be easily checked by spraying with the usual Paris green solution.

The Fall Canker Worm, (*Anisopteryx pometaria*, Harris).

The next insect which I desire to mention is by no means a recent intruder, but one which has been frequently brought to the notice of our members and the public at large. I refer to that very destructive insect the Canker Worm, (*Anisopteryx pometaria*). This species, and the very similar *Paleacrita vernata*, Peck, were clearly described for us many years ago by the then President of the Society, Prof. Saunders. (Ann. Rept. VI., p. 26, 1875), and were illustrated by the beautiful figures of Prof. Riley.

Fig. 11.
Fig. 11, represents the Fall Canker Worm *A. pometaria*; *a*, the winged male; *b*, the wingless female; *c*, a portion of an antenna magnified; *d*, segment of larva, magnified,

Fig. 12.
Fig 12, the Spring Canker Worm (*P. vernata*); *a*, the winged male; *b*, the wingless female; *c*, a portion of an antenna magnified; *d*, segment of larva, highly magnified.

It is nearly a century since Prof. Peck, one of the earliest of American entomologists, penned his "Natural History of the Canker Worm," which even then was making itself known as a depredator in the New England orchards. Our two species of moths resemble each other so very closely, both in the larval and adult stages, that the trained entomologist alone can readily distinguish them. This, however, is not a matter of very great importance from the economic standpoint, as the habits of both species are identically the same, and the same course of treatment will destroy the one or the other.

The species are generally distinguished as the spring and autumn Canker Worms, but the larvæ of both species appear in early summer and have the same pernicious habits of reaping where they have not sowed. These larvæ are pale greenish "loopers" when young, becoming more striped and darker with successive moults. Voracious eaters, they rapidly defoliate the trees upon which they feed, and when fully grown they drop, by silken threads, to the ground, to burrow a few inches below the surface and construct a cell in which to pupate, the moths appearing partly in the autumn and partly in the spring.

In his address last year Dr. Bethune made mention of the abundance of Canker Worms at several places in Canada, one of these being Ottawa. Having watched the

appearance of the pest during the past three seasons, I wish to make a few remarks upon the species which has been the cause of so much disfigurement of our shade and forest trees. The past summer was the third in which the attack has been severe, but there are indications that the crisis has been passed and that we shall probably next year have a less numerous host at work. The species which has been infesting our district is that known as the Fall Canker Worm, *A. pometaria*, and I am informed by my friend Mr. Fletcher, who has a fuller knowledge of the lepidoptera, that the other species (*vernata*), does not occur here.

While a variety of trees have been more or less injured, it was easily observed that the basswoods were one of the favorite objects of attack, and the large succulent leaves of this densely foliaged tree were speedily riddled, and entirely eaten away by the swarms of caterpillars. In 1892 the ash trees suffered very much, and in many localities were also almost defoliated. In one locality especially, where some fine trees grew on the margins of a low meadow, the excrement dropped by the feeding swarms pattered like a heavy shower on the ground beneath, and walking beneath the trees was rendered most unpleasant on account of the scores of dangling worms, fallen from aloft and swinging to and fro on their silken lines. One soon got liberally sprinkled with worms, and at the same time had the unpleasant sensation of the threads across his face like so many strong cobwebs. The caterpillars which had fallen were of course anxious to return to the feast, and could be seen crawling upward upon every trunk. A natural result of this upward movement was, that all that got on one's clothing soon reached the collar, where they circled around in a most disagreeable manner seeking a way to go still higher, and liable to be crushed by any movement of the head.

This year the attack in that locality was much lessened, either through the influence of predaceous and parasitic enemies, or by flooding of the ground in the winter and spring. Groves of hickories (*Carya amara*) on the higher land adjoining, were pretty well defoliated, but here the Canker Worms were assisted in their work of destruction by several other species of caterpillars. The Canker Worms were most abundant during the first week of June, but by the 20th they were mostly finished feeding and had dropped to the ground. During the period of their presence upon the trees I tried to

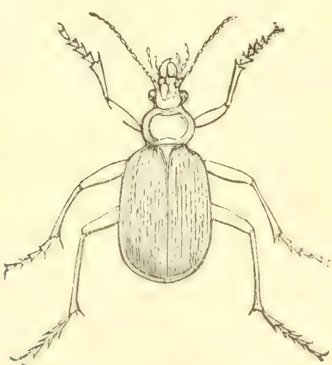

Fig. 13.

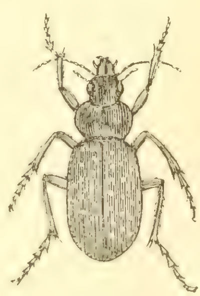

Fig. 14.

observe as often as possible the enemies by which they appeared to be attacked, and it has been encouraging to find that some of these have increased rapidly in numbers, concurrently with the increase of the worms. This has been especially noticeable in the case of the fine beetle *Calosoma frigidum*, Kirby, which belongs to the same section of the genus as *C. scrutator*, Fig. 13, and *C. willcoxi*, the beautiful large green beetles which occur plentifully in some parts of Ontario, but whose range does not extend as far eastward as Ottawa. The tree climbing and larvæ-seeking habits of these splendid insects are well known, and *frigidum*, which has a more northerly and easterly distribution, appears to have the same arboreal and predatory habits. Our other common species, *C. calidum*, Fig. 14, is essentially a ground beetle and is a most persistent destroyer of cutworms. While

frigidum has the more graceful shape of the *scrutator* group, it is quite black, and bears three rows of small bronzed or greenish punctures, which are, however, much less conspicuous than those of *calidum*.

As an evidence of the rapid increase of *frigidum* during the recent infestation of Canker Worms, it need only be mentioned that my first capture of this beetle was on 23rd May, 1883, on an island about three miles below the city, and that no other specimen was taken by me until 28th June, 1891. During these eight years a careful watch had been kept for this species, and many additions of less conspicuous beetles had been made to my local lists, so that I was forced to the conclusion that it was one of our rarest species. In 1892, however, as recorded in *Ottawa Naturalist* (Vol. VI,, p, 150), I found several specimens in a locality where the Canker Worms were very numerous upon ash trees, and also took two specimens in the city. This spring the beetles were found to be quite abundant under stones, etc., in the infested localities, and later when the worms made their appearance on the foliage they were soon attacked and greedily devoured by the beetles. Numerous examples of *frigidum* were seen ascending the trunks of the basswoods and extending their investigation as high as they could be watched. The worms seemed to be easily disturbed by the marauders, and when a beetle ran out on a leaf they would drop down a few inches to elude it, One of the less alert, or newly moulted worms, would, however, be captured, and it took a very few seconds for the beetle to devour the juicy body of its prey and to recommence the hunt. Enormous numbers of the worms must have been thus devoured by this beneficial beetle. At the Experimental Farm, the beetle was also found in some numbers on infested basswoods, showing that its range was becoming more extended.

The Canker Worms were also attacked by parasitic hymenoptera, which, though less conspicuous, may not have been less destructive than the beetles. One of these which I have bred is apparently *Apanteles paleacritæ*, a Braconid, described by Prof. Riley, (Trans. St. Louis Acad. Science, Vol. IV., p. 313), from 3 females, 1 male, bred from the larvæ of *Paleacrita vernata*, found at Villa Ridge, Southern Illinois, the flies appearing May 10th, and from 2 females bred from Canker Worm larvæ, probably of the same species, received from Mr. J. Pettit, Canada West. This Apanteles differs from *A. congregatus* and other common allied species, in that the host only supports a single larva, which, however, seems to so exhaust its vitality that it does not reach maturity. Dr. Riley says that: "The greenish white cocoons are spun singly on the under side of a leaf," but I have often found that the parasitic grub, when satiated with the juice of the unfortunate Canker Worm, emerges from its back and spins its cocoon thereon; the emaciated worm bearing this upright burden, like a tower on his back, wanders feebly about until death claims and relieves him.

On the hickories I found numbers of the Canker Worms which had succumbed to a different internal parasite, and had become mere contracted and stiffened shells, attached to the leaves and stems on which they had died. Such a condition results with some caterpillars from the attacks of species of the Ophionid genus Limneria, and perhaps may have so resulted in this instance, but from a number of specimens collected I bred invariably a species of Hemiteles, the members of which genus are considered secondary or hyper-parasites. I have not yet had time to thoroughly identify the pretty little species bred from the Canker Worms, but it resembles *H.* [illegible], Prov., in having two well defined bands on the wings, although evidently a distinct species, and closely related to *H. melitææ*, Ashm., if not identical with that species, which occurs in California. Another ichneumon which was quite common about the infested hickories was the handsome *Mesostenus thoracicus*, Cress, usually a rare insect, and I supposed from its unusual abundance that it was parasitic on the Canker-worms. After closely watching their movements, however, I ascertained that they were searching for the rough cases made by a species of leaf-folding caterpillar, and that they perhaps confined their attention to this species which was somewhat abundant. I collected some of the folded leaves and bred from them both the parasite and the moth, the latter a pretty little species, which Mr. Moffat has kindly identified for me, and of which he says: "The name of the moth is *Ambesa Walsinghami*, Rag, as identified for me by Prof. Fernald from a single specimen taken at Hamilton several years ago, and I have never met with another. It belongs to

the Phycitidae and Hulst gives its habitat as Cal., but gives no intimation of its food plant." In addition to this insect and the Canker-worm, there were several geometrid and other larvæ infesting the hickories, but I had not the time to collect or examine them.

While the Canker-worm is a very destructive insect, it fortunately does not extend

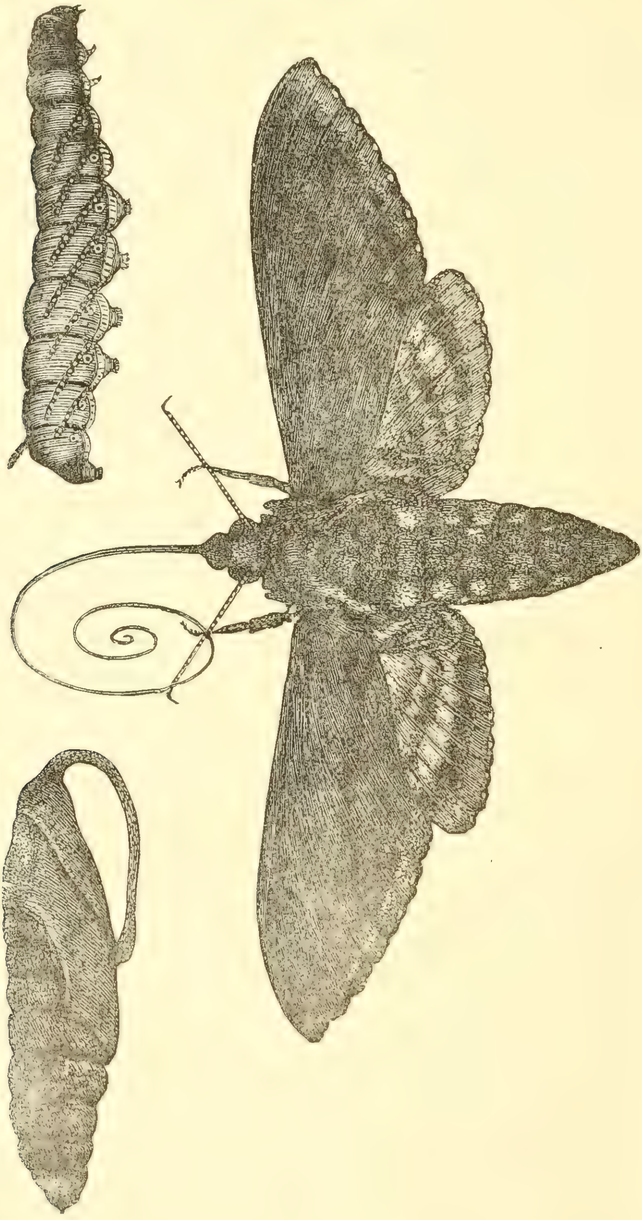

Fig. 15.

the area of its ravages very rapidly, as the females are wingless, and generally deposit their eggs upon the trees beneath which they have emerged from the ground where the caterpillars buried for pupation. The insect is thus not a difficult one to deal with when it infests the orchard or shade trees. The females may be prevented from climbing

up the trunks by means of sticky bands or funnel-shaped collars of tin. When thus stopped they often deposit their eggs below the obstruction, where they may be easily scraped off or destroyed by brushing with coal oil. When the attack is not observed until the worms are feeding, they may be sprayed with Paris green (one pound to 200 gallons of water), or may even be jarred from the trees and then destroyed. If they have been allowed to become full grown, and have buried themselves, plowing to the depth of a few inches, late in the autumn will expose them to the frost. The spraying of the trees when the young larvæ are feeding is the most effectual means of destroying the insects.

MISCELLANEOUS INSECTS.

The Tomato-worm, the large caterpillar of the Hawk-moth, *Sphinx quinquemaculata*, Fig. 15, which last year was reported in some portions of Ontario very destructive to both tomatoes and potatoes (Fletcher, Rept. Exp, Farms, 1892, p, 161), has not proved so troublesome this season. The decrease of this obnoxious caterpillar may be largely due to the increased abundance of the little Braconid fly, *Apanteles congregatus*, with the little white cocoons of which the worms may be sometimes found almost covered, as many as 200 larvæ of the parasite feeding and developing in one caterpillar. The Fall-Web-worm, *Hyphantria cunea*, Fig. 16, continues to be very abundant, and its unsightly webs disfigure a great many trees throughout the country, although there is no reason why its ravages should be permitted in gardens, orchards or lawns, where a little care in removing the colonies of young worms would soon greatly reduce the pest. In the Maritime Provinces it seems fully as common as in Ontario and is one of the most noticeable insects.

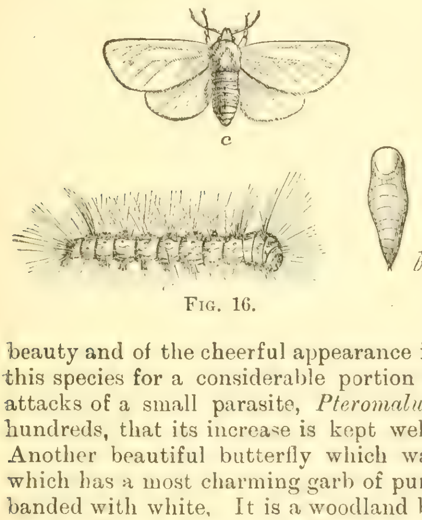

FIG. 16.

The handsome "Mourning Cloak" butterfly, *Vanessa Antiopa*, whose rich purple wings are broadly margined with golden yellow, has been in unusual abundance this year, and its black spiny caterpillars have seriously defoliated the elms and willows. Because of its beauty and of the cheerful appearance it makes in the early days of spring, we can forgive this species for a considerable portion of its depredations. It is also so subject to the attacks of a small parasite, *Pteromalus puparum*, of which a single chrysalis contains hundreds, that its increase is kept well under control without the interference of man. Another beautiful butterfly which was unusually abundant, was *Limenitis Arthemis*, which has a most charming garb of purple, variegated with shimmering blue and broadly banded with white. It is a woodland butterfly, flitting gracefully along the paths through woods or about their margins, and thus hiding its beauty from the city residents, whereas the more hardy Antiopa enjoys both city and country life.

Plant-lice of various species are a continual source of trouble and loss to plant growers and fruit-raisers, and the Apple-aphis may be cited as one of the more injurious species. Another plant-louse has badly infested the ornamental shrub known as Snowball, and much disfigured them by curling and shrivelling the leaves. The attacks of such insects can be easily treated with a spraying of the kerosene emulsion recommended by Mr. Fletcher, in Bulletin 11, Central Exp. Farm, which tells how to prepare and apply the most efficacious remedies for many injurious insects.

Several species of beetles have come under my notice as having been injuriously abundant during the year. Among those were two of our common Blister-beetles—*Macrobasis unicolor*, the Grey Blister-beetle, Fig. 17*a*, was reported as infesting potatoes,

a crop which is not infrequently attacked by this insect, and in New Brunswick it was also found destroying horse-beans, which are now being somewhat extensively grown with corn for ensilage. The favorite native food of this beetle appears to be the Meadow-rue (*Thalictrum cornuti*), but it is also quite satisfied with the foliage of the Basswoods. The Black Blister-beetle, *Epicauta pennsylvanica*, Fig. 17*b*, has been reported infesting German asters and mangels, and has been previously known as attacking carrots, cabbages, and beets. The method of attack by these two species of Blister-beetles is much alike, and they sometimes may suddenly appear in very great numbers. Their depredations need not, however, be much feared, as they are only committed by the adult, or fully developed insects, and are of comparatively short duration. They may be readily checked by dusting with lime or plaster, or in extreme cases by sprinkling with paris green. In the larval stage the Blister-beetles are parasitic in their mode of life and some of the species render good service in destroying the eggs of grasshoppers. In Manitoba and the N. W. Territories a larger species, *Cantharis Nutalli*, is very abundant, and at times troublesome, and one or two species have been recorded as pests in British Columbia.

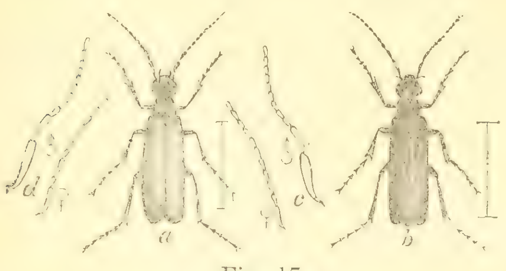

Fig. 17.

The Spotted Tortoise-beetle, *Chelimorpha argus*, Licht, was brought to me several times as a destructive beetle, but its presence on some of the plants said to be attacked was undoubtedly accidental. The larvæ of this beetle feed, in common with those of our species of Helmet beetles (Coptocycla) on the common wild convolvulus. They are disagreeable looking spiny grubs, carrying their cast-off skins upon their backs like a bundle of old clothes. Before pupating, if their food plant has been pretty well destroyed, they may wander off and attach themselves to adjacent plants. They have been said to feed on potato, and on raspberry, but, if these were carefully made observations, it is probable that the proper food plant had been exhausted, and the larvæ had sought the nearest plants. The Morning-glory, which belongs to the Convolvulaceæ, is subject to their attacks, and one instance came to my notice this season, in which serious havoc was made with the form of this creeper known as the Rose of Sharon.

In the Maritime Provinces the Pear-blight Beetle, *Xyloborus dispar*, which belongs to the Scolytidæ, or family of small bark-borers, continues to cause much alarm to the proprietors of the famous apple orchards, as it appears to attack healthy trees as well as those whose vigor has been impaired. If it continues to spread, this minute beetle will be the source of much loss, and will be extremely difficult to combat.

Grasshoppers, which two years ago were unusually abundant and destructive, especially in oat-fields, in this section of country, were, probably on account of the very wet spring and summer, much less numerous this season and comparatively harmless. In the western parts of the Province, as for instance in the neighborhood of Lake Simcoe, where dry weather prevailed, they proved very destructive; the season being favorable to their development, while at the same time reducing the vigor of the plants subject to their ravages. The three common species occurring were *Melanoplus femur rubrum*, *M. atlanis*, and *M. femoratus*.

The Cattle Horn-fly, *Hæmatobia serrata*, has continued to extend its area during the past season, and has undoubtedly caused a very serious loss to the stock-raiser and dairyman. While the animals may not be dangerously or permanently injured by its attacks, the irritation is so great that sores are produced by the rubbing and licking by which they strive to relieve it, and the general effect is to cause the beasts to "fall off rapidly both in flesh and in yield of milk." For farther information regarding this recent and serious pest, I would refer you to the excellent paper by Mr. Fletcher in our last Annual

Report, or to his Bulletin on the Horn-fly (Central Exp. Farm, No. 14.) As the dairy and stock-raising interests of Canada are of such great importance it is sincerely to be hoped that this plague of flies is but a temporary one.

Parasitism in Insects.

This, to me, is one of the most interesting problems in entomology, and the subject has been admirably dealt with by Prof. Riley, in his address as President of the Entomological Society of Washington last year (Proc. Ent. Soc., Wash., Vol. II., pages 397-431). After a mention of the animals affected (chiefly mammals, birds and insects), he defines the scope and meaning of the term parasite, and suggests the separation of parasitic forms into three groups. First, *Parasites Proper*, including insects whose whole life is passed upon and is dependent upon their host, and which may be sub-divided into *external*, as lice, and *internal* (or sub-cutaneous), as the itch-mite, etc. Second, *Fatal Parasites*, which, in the larval stage, live at the expense of the members of their own class. These are also sub-divided into *internal*, where the larva is nourished within the host upon the surrounding fluids, as are the majority of Hymenopterous parasites, and *external*, where the larva attaches itself to the host, as in Thalessa, and sucks its juices; to this sub-division belong many hymenopterous, dipterous and coleopterous parasites. Third, *Inquilinous Parasites*, which includes the numerous forms which live upon the provision made by other species for the sustenance of their offspring, or which are found habitually associated with other insects, but not injurious to them. This class is sub-divided into *fatal inquilines*, where the guest's living means starvation and death to the host, and *commensals*, where association is mutually harmless, as where beetles are found living in the nests of bees and ants.

An outline is then given of the parasitic forms occurring in the several orders of insects, with reference to some of the principal and more interesting groups. The Hymenoptera furnish by far the greatest number of species, which, by their abundance and rapidity of reproduction, tend to check and reduce the undue prevalence of other insects. Some of the most interesting parasites belong to the Coleoptera, especially those forms of which the larvæ in the first stage are named triungulins, and which later, when the host has been reached and food assured, gradually become helpless grubs. Such are the Oil-beetles and Blister-beetles in the larval stages. The Diptera furnish the well-known Tachinid flies which deposit their eggs upon caterpillars and other insects, the footless maggot penetrating the body of the victim and feasting therein. These forms are very numerous and destroy enormous numbers of insects, such as the Tent-caterpillars, etc. The order furnishes also many other important groups of parasitic species varying much in habits, such as the bot-flies and tick-flies. We may also include under this order the fleas. In the Hemiptera are found the true lice, unpleasant little creatures, subsisting on the blood of mammals and not even exempting man, especially if he be indifferent as to cleanliness of body and raiment. The bed-bug is often spoken of as a parasite, but is so, to such a limited extent, as not to fall into any of the classes enumerated, being merely predaceous in habit, a distinction which should be born in mind, as there are many predaceous insects which do not come under the stigma of parasitism.

The Platyptera (bird-lice) and Arachnoidea (Ticks and Mites) contain numerous species, principally external irritants, but the remaining orders of insects are almost free from any parasitic inclinations.

The causes which might produce the parasitic habit are then considered, and the effects of the parasitic life, which produces degradation both by limiting the freedom of motion and by obliterating structural features common to closely allied non-parasitic forms, although at the same time certain organs may gradually become highly modified and specialized to meet the requirements of the new conditions of life. The modifications observed are both external and internal, and form in themselves an extensive subject for consideration. Finally the economic bearing of parasitism is briefly referred to, and it is shown that the agriculturist is very greatly aided by the numerous species which subsist upon phytophagous insects. The address is one well worthy of careful study, and, as has been elsewhere remarked, would serve as a basis of a very acceptable volume.

ENTOMOLOGICAL PUBLICATIONS.

The study of Entomology from an economic standpoint, has, of recent years, been rapidly developed in America, and the Association of Economic Entomologists, organized to bring together the workers in this field of applied science, must exercise a powerful influence upon future investigations of this nature. The agriculturist will have no excuse, for remaining in ignorance of at least an elementary knowledge of his insect enemies when the results of the investigations of trained entomologists in every section of the country are so frequently and freely issued in bulletins and reports.

In Canada our Society has been a pioneer in this direction, and for more than a score of years has issued an Annual Report, which is generously distributed by the Ontario Department of Agriculture. In more recent years the Dominion Government has sought to assist and develop the agricultural interests of the various Provinces and Territories, by the establishment of Experimental Farms. These are under the direction of Prof. Saunders, for several years President of this Society, who is well-known as a writer on economic entomology, and especially by his able treatise on Insects injurious to Fruits, which is a standard text-book for fruit-growers throughout America. He is fortunate in having associated with him, as Entomologist and Botanist, Mr. Fletcher, who has also been more than once our president, and whose industry and scientific acquirements render him unusually well-qualified to occupy such a difficult and responsible position. His yearly reports and occasional bulletins are replete with information clearly and concisely expressed, and, as they are gratuitously supplied to applicants interested in these subjects, it is unnecessary for any one to suffer insect depredations to go unchecked.

In the United States the Division of Entomology at Washington, under the guidance of the most eminent of all economic entomologists, Prof. Riley, assisted by a staff of numerous trained and skilful observers, conducts most thorough investigations in all parts of the country where any pest attains unusual prominence. The publications, based upon these researches, are most valuable and reliable records of the habits of injurious species, the parasites from which they suffer and the remedies which may be most easily and effectually employed against them. A complete series of the publications issued up to date forms in itself a very valuable library. The Smithsonian Institution, in the Bulletins of the U. S. National Museum and other publications, affords to authors a means of issuing more extensive and exhaustive monographs than could be received by the regular entomological journals. Among recent issues from this great source of scientific knowledge may be mentioned the Directions for Collecting and Preserving Insects, by Prof. Riley, which is the most complete and satisfactory text-book known to me on a subject which forms the basis of all entomological study and advancement. A larger work, although appealing to a more specialized and limited class of readers, is Bulletin No. 44, in which Prof. John B. Smith gives a further proof of his untiring energy and ability in a Catalogue of the Lepidopterous Sub-family Noctuidæ, found in Boreal America, forming a volume of 400 pages.

The various State Entomologists, Agricultural Colleges and Experiment Stations swell the tide with reports and bulletins. It would take too long to enumerate even the most important of these, but mention may be made of the many valuable reports of Lintner, Comstock and Forbes, to indicate the character of the work accomplished by such professional workers in the wide field of economic entomology.

The general literature relating to insects increases with great rapidity, and the yearly additions are so voluminous as to be almost discouraging to students who desire to have, or to know, all that is being published. The record of entomological writings of 1892 (Insecta ; Dr. Sharp) gives over one thousand titles of papers. It is scarcely possible for any of us to obtain, or even see, all these writings, however much we may desire to possess, or, at least, to peruse them, but a certain number of publications are necessary if we desire to obtain a knowledge even of our own fauna.

Of these, *The Canadian Entomologist*, now completing its twenty-fifth volume, is the most essential to Canadian students, and, although dealing more especially with the insects of our own dominions, it contains many valuable contributions from wider fields, by the most noted entomologists of the day. Under the careful editorship of our late President, Dr. Bethune, it shows a steady improvement in quality and quantity of matter, and

(started Aug. 1868) enters promisingly upon its second quarter of a century. This is the only Canadian journal devoted to Entomology, but the *Ottawa Naturalist*, published monthly by the Ottawa Field-Naturalists' Club, frequently contains valuable papers and reports on the insects of the surrounding section of country. Occasional entomological contributions also appear in the *Canadian Record of Science*, and possibly in the transactions of other societies.

Of the United States' periodical publications the most important are as follows: Transactions of the American Entomological Society; *Psyche*, issued by the Cambridge Entomological Club; Proceedings of the Entomological Society of Washington: *Entomological News*, by the Academy of Natural Sciences, Philadelphia: *Insect Life*, by the Division of Entomology, Washington, and the *Journal of the New York Entomological Society*, which has recently made a brave and promising entry into the arena.

While the more advanced student may be embarrassed by the wealth of entomological literature provided for him, the beginner has hitherto found the information most needed not to be readily obtained. He has had to seek here and there a little, like the bee gathering honey, and has lost much valuable time in the search, as does the bee when flowers are scattered. A new era seems to be now opening, and the long road is being cleared and smoothed for him. Dr. Riley's directions for collecting and preserving insects enable him to prepare good specimens and to form satisfactory collections, and by the aid of Dr. Packard's "Entomology for Beginners," or Prof. Comstock's "Introduction to Entomology" (Part I. only issued) he can study their structure and classification. The next stage, the identification of specimens, without having to impose upon more advanced students the labor of naming even the commonest forms, promises soon to be covered by the issue of hand-books on the various orders, in which will be gathered generic and specific descriptions, now often scattered in foreign and miscellaneous literatures, accessible but to the favoured few.

Such a help to the determination of the diurnal lepidoptera has already been issued by Dr. Scudder, under the title of "A Brief Guide to the Commoner Butterflies of the United States and Canada." The introductory chapters narrate clearly and concisely the structure and habits of butterflies, and are followed by carefully arranged tables for readily determining the species. The omission of rare forms makes these tables less complicated without lessening the value of the work to the young students for whom it is specially intended. Each species is fully described in its several stages, and interesting facts are added in regard to its habits of life. Those who may consider themselves too far advanced to profit by this valuable little book will await with interest the author's promised "Manual of the Butterflies of North America." From the same facile pen we have also a charming little volume for the general reader, on the Milk-weed Butterfly, simply written and devoid of technicalities, yet giving not only the life history of the species selected as a type of our "winged flower," but much of interest in regard to its tribe.

The *Journal* of the New York Entomological Society informs its readers that the preparation of a Hand-book of Coleoptera found in North-eastern America is contemplated, and is now publishing a preliminary catalogue of the species, compiled, from printed and manuscript lists of various entomologists, by Messrs. Leng and Beutenmuller, who express the hope that they may be notified of any corrections or additions tending to perfect the catalogue. When this hand-book appears the Butterfly and Beetle collectors will be well-equipped, and the students of the remaining, equally important if less generally attractive, orders will await the preparation at a later date of manuals to meet their needs.

In conclusion, I have to express the great degree of satisfaction derived from the knowledge that our Entomological Society continues to find itself in a healthy and progressive condition, and to apply itself faithfully to the study of those innumerable forms of life, which, though individually minute and feeble, are in the aggregate a very important factor in modifying the conditions of existence of even man himself. Upon each fellow-member I would urge the necessity of constant work in some selected section of the great field of Entomology, for only by untiring effort, and often by considerable self-denial, can we master its problems and utilize our investigations for the benefit of others. I shall gratefully remember the honour, which I have this year enjoyed, of having been the chief officer of this important Society, and shall strive in the future, as in the past, to assist in its labors.

ENTOMOLOGICAL MISTAKES OF AUTHORS.

REV. THOMAS W. FYLES, F.L.S., SOUTH QUEBEC.

I lately took up Gage's Second Reader, authorized for use in the schools of Quebec, Manitoba, British Columbia and the North West Territories; and I opened it at the chapter entitled "How a Butterfly came." I was curious to know the value of the lesson in Natural History provided in this authorized work for the children of the provinces and territories named; and I read it carefully. The lesson tells that

"Late in September a lady saw a worm upon a willow leaf."

The worm is described; and a rude cut of it is given.

"The lady carried leaf and sleeper home. She took willow leaves for it to eat, put them all in a glass dish, and tied lace over it. In just one week her guest was gone; only a lovely green bag was left."

Here the bag is represented.

"It was just one inch long, was made very neatly, and looked much like a little bed or cradle. No stitches could be seen, and the seams had an edge like gold cord. Gold and black dots like tiny buttons were on it. The caterpillar had sewed himself in." . . . "Almost six weeks the little sleeper lay in his silken cradle. Early in November he burst the pretty green hammock." . . . "A lovely butterfly came out out. It had brown and golden wings, with stripes of black like cords on them, and a feathery fringe of white for each stripe On the edges of the wings were white and yellow dots. The head was black and also had white and yellow dots on it."

Here comes a representation of a butterfly—decidedly a *Papilio.*

"The inside of the wings was darker; it was like orange-tinted velvet. All these changes were in less than two months."

The caricatures of the larva and pupa given, and the descriptions of the insect in its different stages, are faintly suggestive of *Danais Archippus*; but Archippus feeds on *Asclepias*; and Archippus is not a *Papilio. Papilio Turnus* is, I believe, sometimes found on the willow; but the description and the cuts of larva and pupa are not even *faintly* suggestive of this species.

What insect is really meant in the lesson I am quite unable to determine; but this I can with confidence say: The Canadian child, who may be led by this chapter in the Second Reader to search the willows late in September, for banded worms two inches long, that will in a few days sew themselves into silken bags, out of which, in November, swallow-tail butterflies will come, will simply have its labor for its pains.

This wonderful lesson in Entomology upon "How a Butterfly Came" set me "a-thinking," and led me to make various mental and literary excursions. For example: I have accompanied poor "Tom" in Charles Kingsley's "Water Babies" to the "other-end-of-nowhere," and sat at the feet of "Mother Carey," and learned from her that the fairy who made butterflies was not nearly so clever as the fairy "who made butterflies make themselves." This lesson, I take it, was intended for a sly joke at the evolutionists, and suggests the question, How did the butterfly and other insects originally come?

The Egyptians told Herodotus that some living things were generated from the slime of the river and the sea; Pliny supposed that insects sprang from the dew falling upon leaves; Virgil thought that bees might spring from the corrupting bowels of slain beasts; Pietro Martire that "gnattes of divers kindes" were "ingendered of moyste heate"; Ashmole assured Pepys—at any rate Pepys tell us so in his "Diary" under date of April 23rd, 1661—that "many insects do often fall from the sky ready formed;" Swedenborg taught that worms are "procreated from the effluvia of the earth, and from the exhalation of vapors of vegetables, by which the atmospheres are impregnated;" and Du Bartas that God

"By his wise power made many creatures breed of lifeless bodies . . .
So the cold humour breeds the salamander . . . . .
So, in the fire, in burning furnace springs
The fly Perausta."

All these worthies were mistaken—as much so as a very modern *savant* in the person of a little school-boy, who a few days ago told me gravely that "if I would put a horse-hair

into the water and keep it there, it would turn into a snake." He did not make a disciple of me, for I had read Cobbold's, Leidy's and Agassiz's observations on *Gordius aquaticus*, etc.

I have come to this conclusion that whether we go to the "other-end-of-nowhere," or to "the uttermost parts of the morning," we shall find nothing better to rest upon than the old statement, "God said, Let the earth bring forth the living creature after his kind, cattle, *and creeping thing*, and beast of the earth after his kind; and it was so." Gen. I, 24.

That every kind has its own well-ordered and fitting life-history we are assured, from the success that has attended the efforts of entomologists in following through their various stages of existence many of the most minute and obscure of living things.

I have shewn that an authorized school-book may be misleading—the school master's desk is not *always* the seat of entomological authority.

From the pulpit too, hard sayings sometimes reach our ears.

In the language of the ancients, as you know, the word Psyche meant both *a butterfly* and *the soul*. And in ancient art an association of the two ideas was embodied, in a figure of a beautiful damsel holding an expiring torch in one hand and a butterfly in the other. In this manner, the soul escaping from the worn-out body was portrayed. Christian writers have endeavored to improve upon their imagery, and in doing so have erred. They have compared man's earthly life to the caterpillar state of the insect, the tenantless body to the aurelia, and the future glorified body to the imago of the insect. In all this there is an evident straining of the analogy. The apostle St. Paul, to illustrate the great doctrine of the resurrection, said: "Thou fool that which thou sowest is not quickened except it die" (I Cor. XV, 36). But under normal conditions an insect does not die in the aurelia stage—death with it is the final scene—and so we never find the inspired writers making use of the metamorphoses of insects to illustrate that great doctrine.

One quotation from a modern writer will show at once, and better than a long argument, the inappropriateness of such illustrations In the 2nd vol. of "Sermons for the Christian year" by the Rev. William H. Lewis, D.D., Rector of Christ Church, Watertown, Conn., page 312, we read:

> "We stand by the sedgy pond, and see dark forms of water-insects skating along, that could not live a moment if they were taken in that state out of the waves, just as we could not bear with such bodies as we now have the life of heaven; but by and by these insects" (appear ?) "to sicken and die, and lie motionless for a while, and then a creature rises to the surface, climbs up some reed or flag, and dries itself awhile in the sun, and then flashes through the air, with the splendid wings of the dragon fly, perhaps. Nor could it live in its old home in the waters any more; just as man raised in his spiritual body will no longer be fitted for such life as he now lives on earth. It is an emblem of the resurrection—a creature of one world, or element, passing by decay and seeming death to another."

Unfortunately for this illustration, the nymph of the dragon-fly is both active and predaceous, and carries on its pursuits until the very hour in which it ascends the stem of a water-plant, or other prominence, from which, as from a vantage-ground, as soon as its outer skin is ruptured and cast off, the transformed body takes its flight to pursue its depredations in the upper air.

The illustration is a very unsavoury one. The Libellula is a terror to its neighbours in every stage of its existence; and surely the man who has "bulldozed" his fellow creatures in this world can hardly be warranted in indulging in blissful anticipations of doing the same in the world to come.

The giants among men of letters, the great masters of song and others, who in the strength of genius have trusted to their own observation, have sometimes, by a word, brought before us peculiarities of insect form or habit recognizable in all time. Thus Homer speaks of the *ringed* wasps; Shakespeare of the *mealy* wings of butterflies; Rogers of the glow-worm's *emerald* light; Shelley of the *golden* bee; Tennyson of the "*high-elbowed* grigs that leap in summer grass." Even Horace's "*mali* culices" strikes the musquito-bitten entomologist as singularly appropriate.

But lesser lights who have given rein to fancy, or have imperfectly interpreted the phenomena of nature, have often greatly blundered in treating on entomological subjects.

The entomological mistakes of writers have arisen:

(1) *From sheer ignorance.*—This was the case with the man who translated the pas

sage in the Greek Testament, which tells us that Herod was eaten of worms (*scholeches*, larvæ) and died,* by "He became a Skoletobrote, and died in the enjoyment of that office."

Such also, as regards Natural History, was the case with Bp. Oxenden, when on page 70 of "My First Year in Canada," he wrote:

"The little humming-bird is rather rare, and they are seldom seen but in gardens. They are more like butterflies or gad-flies than birds both as regards their size and habits."

From this slovenly statement we may fairly make this deduction: Since the humming-bird resembles, both in size and habits, the butterfly or the gad-fly, these insects in the same particulars and to the same extent, resemble one another. A somewhat startling entomological conclusion! A lady whom I know, having read the Bishop's book, still speaks of the ruby-throated humming bird as *the Canadian gad-fly.*

Bulwer Lytton makes a remarkable mistake from sheer ignorance of entomology. He describes one of his heroines as a lady of refined tastes, who kept living butterflies in her conservatory. *Some of these she allowed to escape after they had been confined for a year.* ("Kenelm Chillingley," Bk. V., ch. 5). The veriest tyro in entomology knows that the preservation of a living butterfly for a year would be miraculous. Lytton made a new departure in his statement. The usual tendency of authors has been to shorten the insect's life. Thus Mrs. Barbauld very elegantly says:

"Lo! the bright train their radiant wings unfold,
With silver fringed and freckled o'er with gold.
On the gay bosom of some fragrant flower,
They idly fluttering *live their little hour,*
Their life all pleasure and their task all play,
All spring their age, and sunshine all their day."

Another mistake frequently made in ignorance by authors is to portray the butterfly's life as one of unalloyed pleasure. Spenser says of the butterfly that—

—"evermore, with most varietie,
And change of sweetness (for all change is sweet),
He casts his glutton sense to satisfie
Now sucking of the sap of herbe most meet,
Or of the dew, which yet on them doth lie;
Now in the same bathing his tender feet,
And then he percheth on some branch thereby
To weather him, and his moyst wings to dry."

* * * * * * *

"What more felicitie can fall to creature,
Than to enjoy delight with libertie
And to be lord of all the works of Nature?
To reign in the aire from th' earth to highest skie,
To feed on flowers and weeds of glorious feature,
To take whatever thing doth please the eye?
Who rests not pleased with such happiness,
Well worthy he to taste of wretchedness."

Commenting on these lines, Leigh Hunt wisely says:

"After all, Spenser's picture of the butterfly's enjoyment is not complete entomologically. The luxury is perfect, but the reader is not sure that it is all proper butterfly luxury, and that the man does not mix with it. . . . "The butterfly perhaps is no fonder of 'bathing his feet,' than we should be to stick in a tub of treacle. And we ought to hear more of his antennæ, and feathers (for his wings are full of them), and the way in which they modify, or become affected by his enjoyments."—*The Indicator*, ch. LXIV.

The lines are beautiful, but the picture they present of insect delight is altogether overdrawn. St. Paul had a much better appreciation of things when he said, "The whole creation groaneth and travaileth in pain together until now," (Rom. viii., 22). We who have studied insect life can tell of the foes that beset it from its earliest stage to its final scene; the Proctotrypidæ that spoil the eggs; the Ichneumonidæ and Chalcididæ that assail the larvæ; the life-sapping fungi that destroy both larvæ and pupæ; *Phymata erosa* that lies in wait for the perfect insects in the very flower heads that attract them; the Dragon-flies, the Vespidæ, the Crabonidæ, that (as well as the insectivorous birds) pursue them in the upper air, all these form a terrible array of adversaries. Then there are to be borne the dark hours that curb their faculties, the rains that wash away their

*Kai genomenos skolekobrotos exephuxen.—Acts. XII, 23.

beauty, and the winds that wear and fray their wings. In the case of the Vanessidæ and Graptidæ there are the terrible torpidity into which the winter chills them, and what I imagine to be no less terrible, the partial awakenings on intervening milder days.

No greater contrast to the picture presented in the fine verses of Spenser can be shown to us than the *reality*, when in the early spring, a pair of hibernated Graptas—*Grapta Progne*, for example—perform their nuptials. Worn and dilapidated, the bloom and glory of youth swept away from them by winter storms, they furtively and in contradiction to the very name they bear (*Procne*, a swallow, one that shuns the woods), seek the shades and safeguards of the trees, whose lichens and mosses resemble in colour their own sober hues, and there unite themselves. The cycle of their existence is then soon completed, and they perish ere yet the summer has robed the world in beauty.

The judicious writer, whose comments on Spenser's lines I have quoted, says in the same chapter: "A year or two back"—his work was published in 1833—"everybody in London that had a voice was resolved upon being a butterfly born in a bower." When I was a boy the song to which he alludes was still popular, and the melody to which it was sung haunts me still. Copies of it have become scarce. When I was last in England I had great difficulty in finding one. This is how the words run:

"I'd be a butterfly born in a bower
Where roses and lilies and violets meet,
Roving for ever from flower to flower
And kissing all buds that are pretty and sweet,
I'd never languish for wealth or for power,
I'd never sigh to see slaves at my feet,
I'd be a butterfly born in a bower,
And kissing all buds that are pretty and sweet."

"What though you tell me each gay little rover
Shrinks from the blast of the first autumn day,
Surely 'tis better, when summer is over,
To die when all fair things are fading away.
Some in life's winter may toil to discover
Means of procuring a weary delay,
I'd be a butterfly living a rover,
Dying when fair things are fading away."

T. H. Bayley.

Epicurean, is it not? "Let us eat and drink for to-morrow we die." The sentiment is bad, and God, who has fitted all things in just proportions, never gave real ground for false sentiments. As we have seen, the butterfly is not a fit emblem of selfish frivolity. It bears the part in nature that it was destined to bear, and it has to endure its share of ills. Instead of dying when fair things are fading away, many species have to survive the winter, and to perish when fair things are bursting into life, and herein is a truer lesson for those who are aiming at what they are pleased to call a butterfly existence here.

Adelaide Taylor recognized the false sentiment in the song, and in one of those little rhyming lessons on propriety which she and her sisters composed for "infant minds," says,—

"The butterfly, an idle thing,
Nor honey makes, nor yet can sing,
Like to the bee and bird;
Nor does it, like the prudent ant,
Lay up the grain for time of want,
A wise and cautious hoard."

"My youth is but a summer's day,
Then, like the bee and ant, I'll lay
A store of learning by,
And though from flower to flower I rove,
My stock of wisdom I'll improve
Nor be a butterfly."

But in this little lesson we cannot help noticing another very common mistake, that of setting forth the ant as an example of acquisitiveness. Adelaide in the verses quoted suggests the acquisition of learning, but the example is generally taken to suggest the acquisition of wealth. Solomon's words are,—

"Go to the ant, thou sluggard, consider her ways and be wise:
"Which having no guide, overseer, or ruler,
"Provideth her meat in the summer, and gathereth food in the harvest."—*Prov.* VI., 6-8.

Now, the lesson conveyed in these words is only that conveyed in "Whatever thy hand

findeth to do, do it with thy might," or in "Be not slothful in business," or in the homely saying, "Make hay while the sun shines." There is nothing in them to countenance the hoarding propensities of the miser.

It has been supposed that Solomon referred to the *Atta barbara* of Palestine, which, like the *Atta malefaciens* of Texas, is said to store up grain. However this may be, it is very certain that Adelaide Taylor had an English ant—*Formica rufa*, or one of its congeners—in view. Rev. J. G. Wood says,—

"Ants do not, as has been so frequently said, lay up stores of corn for the winter, for they are in a state of torpidity during the cold months, and require no food. Moreover, an ant would find as much difficulty in eating or digesting a grain of corn as we should in devouring a truss of straw."—Ill. Nat. Hist., p. 426.

Thomas Hood, however, in his "Ode on Autumn," goes to the full length of the mistake and says,—

"The ants have brimm'd their garners with ripe grain."

(2) *Many entomological mistakes of authors are found to be exaggerations of the truth.*

Whatever is strange in other lands becomes a "traveller's wonder." Stories of the admiration it excited in the beholders have afforded food for credulity and speculation. Of mistaken ideas the following Eastern Townships' story affords an instance. Two young Irish immigrants landed at Montreal some years ago. They travelled by the then new line to Waterloo, as far as Farnham. They walked from that place to Cowansville, and arrived at the hotel in the dusk of the evening. After supper they retired to their room. It was a hot July night and they threw open the window for air. In flocked the mosquitoes of course, and began to be very attentive to the new-comers. One of the lads, who was already in bed, called to his fellow, "Pat, put out the light and jump in, and then the omadhouns will not find us." Pat put out the light, but at that moment in sailed a fire-fly. "Och, Terry," he exclaimed, "its not a bit of use, one of the spalpeens *has been and got a lanthern.*"

Saint Pierre, the ingenious author of "Paul and Virginia," learned from Father du Tetre concerning *Pyrophorus noctilucus*, and says of it, in his "Studies of Nature," Vol. II., p. 299.

"There are insects which need no pharos to guide them in their nocturnal perigrinations. They carry their *lanterns* with them ; such are the luminous flies."

Pietro Martire, in the "Decades of the New World," tells us that the lanterns of the fire-flies enable them to see the musquitos on the sleepers' noses, and to pick them off. (He says *faces* ; but the whole includes the parts). His account is as follows:

"Hee who understandeth he hath these troublesome guestes (the gnattes) at home, diligently hunteth after the *Cucuij*. Whoso wanteth *Cucuij* goeth out of the house in the first twilight of the night, carrying a burning fire-brande in his hande, and ascendeth the next hillock that the *Cucuij* may see it, and he swingeth the fire-brande about calling Cucuius aloud, and beating the ayre, with often calling out *Cucuie, Cucuie*" . . . . "The hunter having the hunting *Cucuij* returneth home, and, shutting the doore of the house, letteth the preye goe. The *Cucuij* loosed, swiftly flyeth about the whole house, seeking gnattes under their hanging bedds, *and about the faces of them that sleepe*, which the gnattes used to assayle : they seem to execute the office of watchmen, that such as are shut in may quietly rest. Another pleasant and profitable commodity proceedeth from the *Cucuij*. As many eyes as every *Cucuius* openeth, the hoste enjoyeth the light of so many candels ; so that the inhabitants spinne, sewe, weave and dance by the light of the flying *Cucuij*."

The same writer tells us that the inhabitants travelling at night used to tie a fire-fly to each great toe.

Madam Meriam, the authoress of a History of the insects of Surinam, says that the light of the lantern-fly, *Fulgora lanternaria*, is sufficient to read by.

Now, all these stories are "travellers' wonders," and need to be taken *cum grano salis*. Dr. G. A. Perkins, in the *American Naturalist*, Vol. II., p 462, states that—

"By placing the luminous pads of one insect quite near the paper, very fine print can be easily read by its aid, though I cannot imagine the light, even of a large number, to be sufficient for any practical illuminating purposes, as has been affirmed by some writers."

But Southey, the Laureate, trusted to such particulars, and in "Madoc in Aztlan," Canto XVII., telling of Madoc's deliverance by Coatel, says :

"Fast along the forest way,
And fearfully, he followed to the chasm.
She beckon'd and decended, and drew out
From underneath her vest, a cage, or net,
It rather might be called, so fine the twigs
Which knit it, where, confined, two fire-flies gave
Their lustre. By that light did Madoc first
Behold the features of his lovely guide ;
And through the entrance of the cavern gloom,
He followed in full trust."

"Now have they reach'd
The abrupt descent ; there Coatel held forth
Her living lamp, and turning with a smile,
Sweet as good angels wear when they present
Their mortal charge before the Throne of Heaven,
She show'd where little Hoel slept below."

Robert Pollock, the author of the "History of Peter Wilkins," which is an entirely imaginative and unnatural work, may, perhaps, have read of the occasional phosphorescence of earth-worms. At any rate he makes the lighting up of the houses and streets of Arndrumstake to depend upon the supply of "Sweecoes," creatures which were bred by all the well-to-do persons in the community, for the sake of their light-giving properties. The lamps in which they were confined were globular, "like calabashes." The creatures were changed twice a day, and fed on leaves and grass.

Pollock enters into no minute descriptions of these creatures, and gives no particulars as to the breeding of them. He leaves all such things to the imagination of his readers ; and to it we also must leave them.

(3) *Other entomological mistakes of authors have arisen from their launching from the known into the unknown.*

It is a dangerous thing to give the fancy scope on subjects with which one is imperfectly acquainted.

Isaac Walton, in "The Complete Angler" (Fourth Day), gives a brief but accurate account of a larva of the Privet Hawk Moth (*Sphinx Ligustri*). The caterpillar died, "but if it had lived," says Walton, "it had doubtless turned to one of those flies that some call flies of prey, which those that walk by the rivers may, in summer, see fasten on smaller flies, and, I think, make them their food."

It is never safe to make guesses in Entomology. Charles Kingsley knew some things about the Dragon-flies ; but he made a *venture*, and—*he made a slip*. The redoubtable Tom of the "Water Babies" came face to face with an "ugly fellow" who informed him that he wanted to "split."

"Why do you want to split?" said Tom.

"Because my brothers and sisters have all split, and turned into beautiful creatures with wings : and I want to split too. Don't speak to me. I am sure I shall split. I will split!"

A wise resolution, I dare say ; but a little "too previous." However—

"Tom stood still, and watched him, and he swelled himself, and puffed, and stretched himself out stiff. At last, crack, puff, bang—he opened all down his back, and then up to the top of his head.

"And out of his inside came the most slender, elegant, soft creature, as soft and smooth as Tom : but very pale and weak, like a little child who has been ill a long time in a dark room. It moved its legs very feebly ; and looked about it half ashamed, like a girl when she goes for the first time into a ball-room ; and then it began walking slowly up a grass stem to the top of the water.

"Tom was so astonished that he never said a word ; but he stared with all his eyes. And he went up to the top of the water too, and peeped out to see what would happen.

"As the creature sat in the warm bright sun; a wonderful change came over it. It grew strong and firm ; the most lovely colours began to show on its body—blue and yellow and black spots, bars and rings ; out of its back rose four great wings of bright brown gauze ; and its eyes grew so large that they filled all its head, and shone like ten thousand diamonds.

"Oh, you beautiful creature !" said Tom ; and he put out his hand to catch it.

"But the thing whirred up into the air, and hung poised on its wings a moment, and then settled down again by Tom quite fearless.

"No!" it said, "you cannot catch me. I am a dragon-fly now, the king of all the flies."

—"*Water Babies*," Ch. III.

The mistake, of course, in all this is, that Kingsley makes the "splitting" to occur under water. Who ever saw, or heard of before, a dragon-fly bursting from its nymphal case below the surface? Why, it would drown! The nymph extracts oxygen from the water by means of a gill-like arrangement within the abdomen; the perfect insect breathes atmospheric air, through spiracles, as other imagos do. It is the nymph, or pupa, that performs the climbing—not the fly.

Wood, in his "Insects at Home," p. 273, says:

"When the pupa has nearly completed its time it ceases to feed, and the respiration seems difficult and labored. An irrepressible instinct then drives it to leave the water in which it has so long lived: and, seizing the stem of a reed or other aquatic plant, it crawls upwards until it is a foot or two above the surface: clasping the reed firmly with its feet, it sways itself backwards and forwards until the pupal skin splits along the shoulders and the wings and body of the perfect insect shows themselves beneath it," etc.

Mr. Spence, in Chapter XXV of "Kirby and Spence's Introduction to Entomology," points out a mistake made by the poet Darwin respecting the nut-curculio. Darwin's lines referred to are:

"So sleeps in silence the Curculio, shut
In the dark chamber of the cavern'd nut;
Erodes with ivory beak the vaulted shell,
And quits on filmy wings its narrow cell."

It is the maggot and not the beetle that quits the nut—its transformation takes place under ground; and the beak of the perfect insect would be better compared to ebony than ivory. In connection with these lines, Spence says:

"The gratification which the entomologist derives from seeing his favorite study adorned with the graces of poetry is seldom unalloyed with pain, arising from the inaccurate knowledge of the subject in the poet."

(4) *Other entomological mistakes of authors seem to have arisen from mere want of consideration of the balance of circumstances.*

Edgar Allen Poe, in one of his highly sensational tales, tells of "a gold bug." This bug, he informs us, was a scarabæus; but we are not to conclude that it was a right down honest "tumble-bug." The term scarabæus was formerly used for beetles generally. It may have been a sort of *Cotalpa*; but it had some peculiar qualities; ponderosity was one —it was so heavy that it was used as a plumb; but notwithstanding its great weight, it was very active—it flew on before. Then too its pugnacity was remarkably—it bit its captor's hand; and it was not without suspicion of exercising poisonous qualities like the centipede and the tarantula. *I need hardly say that the species has become extinct.*

I have no doubt that many other instances, such as I have adduced, of the entomological mistakes of authors could be found; but these will suffice for the presnt occasion. There is a satisfaction in turning the laugh against men of letters; for some of them have shown a disposition to under-estimate those benevolent, amiable and altogether-worthy gentlemen, who have been good enough to pursue the study of entomology for the benefit of mankind.

For example: Does Fennimore Cooper wish to portray an entomologist? He does so in Dr. Obed Batt; and the crowning scene in which this personage is presented is that in which he is brought forward by the Indians seated upon the *Vespertilio Horribilis Americanus* with his butterflies and other "specimens" disposed about his person—converting him into a sort of perambulating museum.

And yet Fennimore Cooper was considered a decent sort of man! I am told he was a church varden!!

But what shall we say of that horrible fellow Barham, the author of the Ingoldsby Legends, and of the fate that he awarded to an amiable scientific gentleman?

You have read, I dare say, of Vidius Pollio, who, in the days of one of the Caesars, was accustomed to throw his aged and worn-out slaves into his fish-ponds to fatten his lampreys for the market. To such a fate does Barham devote an entomologist, "Sir Thomas." This good man, while searching for nymphæ, tumbles into the water and is

drowned. After a length of time (during which his widow is consoled by the attentions of one Captain McBride) he is fished out in a dilapidated condition ; and, from the pockets and other recesses of his clothing, a number of fat eels are taken. Some of these are cooked for the lady's supper. And this is what she says of them :

" Eels a many I've ate ; but any
So good ne'er tasted before !
They're a fish, too, of which I'm remarkably fond !
So pop Sir Thomas again in the pond —
Poor dear ! *He'll catch us some more.*"

The man, who could imagine such a termination to a useful and honorable career, ought to have been one of the crew of the " Nancy Brig," but *not* the ' long and weedy " survivor !

THE SEASON OF 1893.

By Rev. Thomas W. Fyles, F L.S., South Quebec.

The season of 1893, though it opened somewhat later than usual, has been a favorable one for entomologists. Diurnals in the early part of it were particularly abundant.

My first capture of any kind was made on the 13th of April, when I captured a fine specimen of *Ufeus satyricus* Gr., in a window of the church at Rawdon, P. Que.

After this came a cold spell ; and *Chionobas Jutta*, Hub., which usually appears on the 1st of June, did not show itself till the 3rd. On this date I saw three specimens. On the 7th Mr. H. H. Lyman and I found it in perfection and in fair numbers. The improved drainage of the sourrounding properties is affecting the swamp at Bergerville in which this species is taken—it is not nearly so wet as it was in former years.

The first specimens of *Neonympha Eurytris*, Fabr. (Fig. 18) that—as far as my knowledge extends—have been captured in the vicinity of Quebec, were taken at St. David's by Mr. Hanham on July 1st. This species is not uncommon at Montreal.


Fig. 18.

Debis Portlandia, Fabr., appeared in this neighborhood in the 1st week of July and continued through the month. I have seen worn specimens of the species as late as the 2nd week of August.

Satyrus Nephele, Kirby, first showed itself on July 18th, and very dilapidated specimens of it were to be seen as late as August 31st.

Papilio Turnus, Linn. (Fig. 19) was remarkably plentiful early in the season. I had wondered in former years that it should be abundant at Quebec, seeing that so few apple-trees grow in the vicinity. The mystery was solved when I found the larvae feeding on *Amelanchier Canadensis* which is abundant here.

Œdemasia concinna, A. & S. (Fig. 20) which in the Eastern Townships feeds upon the apple, feeds upon the bramble at Quebec. The larvae in their early stages lie clustered on the under-side of the leaves, and thus escape notice. I found a batch of them on Aug. 5th and took them to my home, where I fed them alternately on bramble and apple. They fed with avidity upon both and throve equally upon them. They attained their growth (Fig. 21) and went into cocoon among dead leaves on the surface of the earth.

Another apple-tree feeder that has to change its diet at Quebec is *Platysamia Cecropia*, Linn. It feeds on the soft maple (*Acer rubrum*) and also, I am inclined to think, on the alder. Last autumn I found two cocoons (Fig. 22) of the species in the midst of an alder swamp, far from tree or shrub of any other sort.

In the Society's 23rd Report I recorded my first captures, on the Heights of Levis, of *Colias interior*, Scud. They were made in the month of September. This year I watched carefully for the appearance of a summer brood. It came in July. I took one or two specimens at St. David's on the 1st of the month, and on the 6th the insect was out in increased numbers. It was gone by the end of the month. As I have said the autumn brood of Interior appears in September.

FIG. 19.

FIG. 20

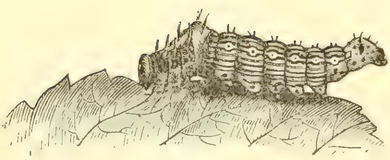

FIG. 21.

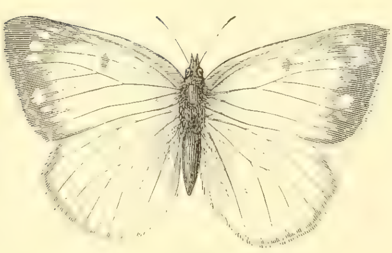

FIG. 23.

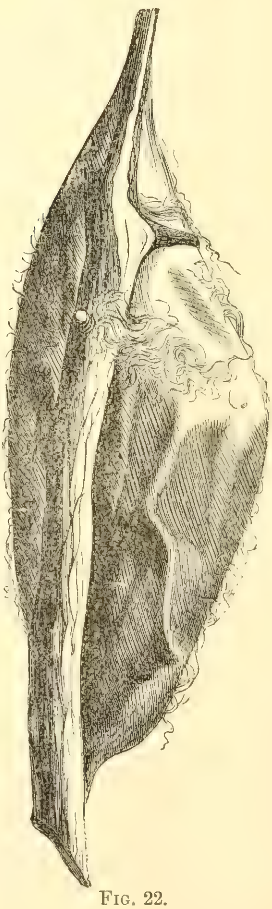

FIG. 22.

In the last week of July a second brood of *Colias Philodice*, Godt. (Fig 23.) appeared. It was out in abundance by the 1st of August. On the 31st of that month worn females were still to be seen laying their eggs on *Vicia cracca*. On the 2nd of October I captured fresh specimens of a third brood of Philodice; and on the 22nd of that month this species was still plentiful, flitting about the flower-heads of Taraxacum.

Argynnis Cybele, Fabr., *Argynnis Aphrodite*, Fabr., and *Argynnis Atlantis* Edw., appear in July. On the 6th of the month they were all on the wing together. I found a full-grown larva of the first named on June 18th. It went into chrysalis on the 20th, and the imago appeared on July 9th. For the escape of this the pupa case was ruptured *on the under side*—the upper remaining intact. On the 31st of August very worn specimens of Atlantis were still on the wing.

Melitœa Harrisii, Scud., was plentiful at Levis, this year at the end of June. It continued till the 2nd week in July. A few years ago I took this species at St. Henri, 9 miles south from Levis. It frequents spots in which its food-plant, *Diplopappus umbellatus*, is abundant.

Limenitis Arthemis, Drury, was rather plentiful from the 1st of July till the middle of the month.

Two of the prizes of the season were taken by Mr. Hanham on the Island of Orleans, viz:

Anisota senatoria, Guen, and *Plusia thyatiroides*, Guen. Thanks to the generosity of Mr. Hanham the former is now in my collection. I have only heard of one previous capture of this insect in the Province of Quebec. It was made some years ago by the late Mr. Bowles.

Other captures worth recording were *Feniseca Tarquinius*, Fabr., Aug. 14th, Isle of Orleans. *Grapta gracilis*, Gr. & R, July 17th, Levis. *Vanessa Milberti*, Godt., July 3rd, Isle of Orleans. *Pyrameis Huntera*, Drury, Aug. 5th, Isle of Orleans. *Hemaris tenuis*, Gr., Aug. 5th, Isle of Orleans.

The season has been a fine one for the "Skippers." The order in which the different kinds of these appeared at Quebec was as follows:

The first to show itself was *Pamphila Zabulon*, Bd.—Lec. It came early in June. While it was still out *Pamphila Taumus* appeared in crowds dodging about the meadows like children "playing tag."

Pamphila Mystic, Edw., presented itself on the 1st of July and continued till the 20th. On the former date Mr. Hanham took a worn specimen of *Carterocephalus Mandan*, Edw., at St. David's, on the south side of the St. Lawrence; and on the 9th of the same month he captured at the same place a specimen of *Amblyscirtes Samoset*, Scud. Both Mandan and Samoset are very rare at Quebec, two or three specimens only of each kind having, to my knowledge, been taken. On the 11th of July *Pamphila Wamsutta*, Harr., and *Pamphila Metacomet*, Harr., showed themselves. At this date Taumus was still plentiful.

Pamphila Manitoba, Scudder, appeared on the 5th of August and continued till the 25th. It was plentiful on the Island of Orleans and on the Heights of Levis (see 23rd Rep., p. 31) frequenting the flower-heads of Solidago and Gnaphalium. On the 10th of the month and again on the 13th I obtained eggs of the species. They were laid dispersedly on blades of grass, etc. Their size (nearly one-twentieth of an inch in diameter at the base) was large in comparison with that of the mother insect. Their shape was that of a gum-drop—flat at the bottom and rounded above. They were white like frosting and in some lights seemed to be irrorated with red, blue and green. *They have not yet hatched.*

An insect which has been very abundant in this locality this season is *Depressaria Heracleana*, De Geer. The species was well and fully described by Dr. Bethune in the *Canadian Entomologist*, vol. II, page 1. In this district it feeds in the umbels of the Cow Parsnip, *Heracleum lanatum*, and, when full fed, bites its way into the hollow-stems of the plant and spins its cocoons in their recesses. The moths come out in the Fall and hibernate.

The Wild Hazel, *Corylus Americanus*, has this year been much infested with the larvæ of a species of Lithocolletis—probably *L. Coryliella*, Chambers. These creatures form circular blisters, about the size of dimes, in the leaves of the plant. In appearance they somewhat resemble the larvæ of *L. hamadryadella* as shown in an article by Prof. Saunders, in the Report of the Fruit-Growers' Association of Ontario for 1882, p. 277. They are about three-tenths of an inch in length, much flattened and having the segments very distinctly marked. In colour they vary from sage-green to amber. The head is small and flat. From the 3rd to the 11th segments inclusive, there are, on the under side, remarkable elongated, brown markings; and on either side of each segment, from the 6th to the 11th inclusive, there is a round, brown spot. The feet are white and are merely warty projections. Along the sides are a few slight bristles. The larvæ have not yet gone into chrysalis but have become more plump and of a lighter tint of amber.

Perhaps the most note-worthy occurrence of the year, from an entomological point of view, has been the amazing numbers of the larvæ of *Catastega aceriella*, Clemens. From Montreal to Quebec and southward to the border they have appeared in myriads. Every maple-leaf seemed to have its tenant.

The operations of the Catastega larva are very remarkable. Working on the under side it gathers around itself a considerable portion of the leaf, securing the lines of contact of the gathered part with a web. Then it bites away portions of the inner skin of the leaf and proceeds to make itself a case; and, as it grows, it enlarges this till it is about an inch and a half long and in shape something like that of a cornucopia. Into this it can completely retire. The larva when full grown is about half-an-inch long, cylindrical, pale green, with an amber-colored head. It attains its growth about the time that the leaves begin to fall. It then vacates its case and spins a slight cocoon between the leaves or in the folds of a leaf. The pupa is about one-fourth of an inch long, pale yellowish brown in colour, having rather large wing-cases and tapering abdominally to a point.

The insect was named by Clemens who mentions it in the Proceedings of the Ent. Soc. of Phil., vol. I (1861), p. 87. He seems to have been acquainted with the case only. There is a reference to the insect in Packard's Forest Insects, p. 409. We shall probably know more about the insect next spring when the imagos begin to appear.

In the meantime, the way to check the increase of the species is obviously to rake up the dead maple-leaves into small piles, and—under favorable circumstances—to burn them.

On August the 23rd, a curious phenomenon was witnessed in Quebec. All the streets of Lower Town were occupied with clouds of winged ants, of the species *Formica flava*, Fabr. The carters had the utmost difficulty in controlling their horses; and the foot-passengers shrouded their faces as they walked along. I read in the papers at the time that a similar plague had appeared in one or two places in the Maritime Provinces.

The Lombardy Poplars in these parts were, this season, affected by a species Pemphigus. The insect produced galls on the leaf-stalks, resembling in size and shape the nut-galls of commerce, and having on one side a slit about three-sixteenths of an inch long. I opened one of the galls on the 6th of July, and found it to be full of insects of the kind, some winged and some wingless. After the galls had withered, I found numbers of apparently the same species of insect, in the wingless state, infesting the young willows near by. The creatures lay thick on the under sides of the twigs sucking the plant-juices.

My last captures this year were made on the 4th of October, when I took *Therina ferridaria*, Hubn. and *Epirrita dilutata*, Bork,* as they were resting on the trunks of trees at Spruce Cliff, Levis. On the same day I saw a fresh female of *Orgyia antiqua*, Linn, laying her eggs on a young spruce.

**E. dilutata* was taken at London, Ontario, about the same time, by Mr. J. Alston Moffatt.

T.W.F.

MOSQUITOES.

By J. Alston Moffat, London, Ont.

The mosquitoes belongs to the order "Diptera," or two winged flies, which includes all insects of whatever size, form or color, which have but two wings, making them easily separable from the Hymenoptera, to which the bees and wasps belong, which are possessed of four wings.

Again, the mosquitoes belong in that order to the family Culicidae which are characterized by long and slender mouth parts, long legs and antennæ, of which there are many genera, and the genus to which the mosquito belongs is called Culex, which is recognizable from the other genera of the family by its biting propensity, whilst the distinguishing, or specific name of our common form, is Pipiens of Linnaeus; a name suggested by the constant piping produced during its flight by the rapid stroke of its narrow wings which are said to vibrate three thousand times a minute. (Fig. 24) represents a mosquito, and (Fig. 25) its mouth-parts highly magnified.

A large number of species have been described and named by different authors—50 are given to Amercia, 35 to Europe and 100 to the rest of the world.

Mr. F. W. Urich, in a paper read before the Trinidad Field Naturalist's Club, says: "So far as Trinidad is concerned I may say I have observed at least ten different kinds of mosquitoes, varying in size and color, and the bite of some of them is far from being pleasant." But as in other departments of natural history, species have been created upon very slight differences, the probability is that many of those so-called "species" are

Fig. 24.

Fig. 25.

but local variations of one species. Yet certain it is, very considerable difference in size is to be observed in the same locality, but as all creatures are given to vary in size, the same liberty may be allowed to Culex pipiens. Whether the bite of the large ones is severer than that of the small ones, does not seem to have been specially observed, but personal experience corroborates the statement that all bites are not equally sharp.

The name Mosquito is a Spanish term, signifying "little fly," and would probably be applied to any biting winged insect, regardless of structure, by the Spaniards who first landed on the continent. And those of them that returned to their own country would relate stories of suffering they had to encounter and endure from their tiny foes; which were of more than Aztec ferocity and tenacity. Even yet extraordinary tales are told of the size and savage nature of the mosquitoes of some localities over those of others. The fame of the New Jersey breed and the Mississippi gallinipper has gone far abroad, but I suspect that the principle cause of suffering in one locality over another, is to be attributed to numbers, rather than to any difference in the size of the insects. Travellers have recorded their experience with mosquitoes in all parts of the world; some declaring that those of the Artic regions are the worst they ever encountered, but South America, from its climatic conditions, and its low-lying lands, which are frequently flooded, is in a position to carry off the prize against the world for its crop of mosquitoes, and that the early travellers there were duly impressed with this fact is evidenced by the names given to

places such as the Mosquito Coast, Mosquito Bay and Mosquito Town. In ancient history we read of armies on the march being arrested on the way and made to beat a hasty retreat from the attack of these tiny warriors, which is quite believeable; for if we take into consideration the scant and loose covering which they probably wore, which gave the wearers so much more space to defend, they were not in a condition to pursue human foes when every man of them was engaged in a double-handed conflict with such pertinacious insect enemies.

There is a prevalent opinion in Europe that mosquitoes are an exclusively American production, and in England especially it is the general belief. We often see it in print and hear it confidently asserted that there are no mosquitoes in England. The usual expression is "We have gnats but no mosquitoes," whilst the fact is, the English Gnat and the American Mosquito cannot be separated generically and probably not even specifically. The two names being but local synonyms for the same insect. But even scientific authorities have assisted in perpetuating the misunderstanding. Newman in his "Familiar introduction to the history of insects," has a paragraph headed "Mosquitoes or Simulites," in which he refers to a wood-cut of a Simulia, which strongly resembles that terrible pest to the early settlers of the country, the "Black Fly," *Simulium molestum*, whilst he gives Gnat as the common name for the genus *Culex*.

The settlers of this country adopted the common name Mosquito for *Culex pipiens*, and used the name Gnat to designate an insect that was more felt than seen. So microscopic was it, that the excessive irritation produced by its attack on exposed parts was often the first intimation of its presence; yet so abundant were they at times, that small clouds of them were distinctly visible from their density. They were active only in the evening, or in densely shaded woods. This pest seems to have entirely disappeared with the clearing up of the country.

Many people call all mosquito-like insects by that name, or, if in Europe, they would call them gnats, and include under these names, the families *Tipulidae* and *Ephemeridae*, which are quite innocent of all biting propensity. So that when these names are used and alarming reports circulated as to their abundance, it is impossible to be quite sure what insect may be meant. It is recorded that in 1736, gnats were so numerous in England, that vast columns of them rose in the air from the spire of Salisbury Cathederal, like smoke, which made the people think it was on fire. Mention is made of a column, pyramidal in form, over a tree, 50 or 60 feet in height (?)—whilst, at a more recent date, another column is mentioned as being seen in a garden 3 feet in diameter and 20 feet high. We may justly conclude that these columns were not composed of *Culex pipiens*. And when we are informed that "every part of these columns was in the liveliest motion," we may at once infer that they were composed of some of the *Ephemeridae*, which Wordsworth alludes to, as

> "The gilded summer flies,
> That mix and weave their sports together in the solar beam."

And when we are told that "their bite was so envenomed that it was attended with violent and alarming inflammation," we may safely say, that these bites did not belong to those columns, but to the genus culex, whose habits are quite different. Who ever saw *Culex pipiens* in a playful mood? She is ever intensely absorbed in business, even her song seems to indicate that her thoughts are bent in that direction; at least it turns ours very quickly to her business methods.

Whilst on the subject of these dancing columns, I will give an illustration of their remarkable powers of sustained flight, which came under my own observation. I was returning from an excursion by rail, on a fine summer evening, and to have an opportunity of enjoying it to the utmost, I took my seat on an open car which had been fitted up to provide extra accommodation. The car in front of me was high roofed, and over a rear corner of it had gathered one of these clusters, high and dense, which was vigorously besporting itself in the rays of the setting sun. I thought to myself "when we go, you will get left," but I was mistaken. When the train started it went with it, and the cluster maintained its position with as much apparent ease as when the car was at rest. Did

each individual of that cluster keep its eye on the car, so as not to fall behind? But it could not accommodate its movements to suit the lateral swaying of the car; every now and again it found itself a little more off or on the corner. It maintained its position until darkness obscured or dispersed the dancers.

Culex pipiens, like many of its relations, lives the earlier part of its life in the water. The female mosquito when ready to deposit her eggs, seeks for stagnant water as the most suitable place on which to do so. The Rev. J. G. Wood thus clearly describes the opperation: "Placing her front legs on a piece of floating stick, straw, or anything that will support her tiny weight, she allows the middle pair of legs to rest on the surface of the water, and crosses the hind pair so as to look like the capital letter X. She then deposits a rather long and spindle-shaped egg, and places it upright with the base downward in the angle of the X. Another egg is quickly placed by the side of the first, and followed by others, all of which are glued together by a cement which is not affected by water. Guided by the crossed legs, the eggs are formed into a boat-like shape, and are left to float on the surface of the water."

These boat-like masses are often longer than wide, the lower end of the eggs being the largest, where the head of the future larva is to be, gives more surface below than above, which naturally turns the ends upwards and helps to give them the boat-like form. In a few days time, according to the weather, the eggs mature and the tiny larva is ushered into what is for the time its native element. In this state it is a particularly interesting creature, large in head, slender in body with two openings at the tail; one situated a little to one side, and surrounded with fine hairs, opens into the breathing tubes, the other being the end of the digestive canal. It is very active, propelling itself through the water with a peculiar jerking and wriggling movement, which has procured for it the appeliative "wriggler," going to the bottom to feed, then rising to the surface to breathe. It may at times be seen resting with its breathing tube above the surface, head down and its mouth-parts moving as if it was taking nourishment Having changed its skin several times, and eaten all it wants, it prepares for another change of form, and throwing aside its larval covering, it emerges a pupa. Its form is greatly altered, much larger at the head end where the mouth-parts, wings and legs of the future mosquito are bunched together in a rudimentary state, the abdomen slender with two propeller-like blades at the end to assist its movements, for it is still active, but more singular still for a pupa, it breathes now not through a tube at the tail as fomerly, but through two projections which it has been provided with, which are situated on the top ot the thorax, so that when it rises to the surface of the water to breathe, it holds its head up now. A wonderful change of habit in so short a time; whilst living in this state, it also enlarges but does not feed. Having thoroughly matured it is now ready to change its aquatic life for an aerial one. The pupa comes to the surface of the water, the thorax rising above it, the hinder part straightens out, and almost immediately the pupa case bursts on the top of the thorax, and the head of the mosquito appears in the opening by a contracting and expanding of the abdomenal segments, the head and thorax are pushed forward and out sufficiently far to free its legs, when it feels for a support which may be the pupa-case which now floats on the water as a boat. The wings now expand, the abdomen is withdrawn from the case, and *Culex pipiens* is off on other business. The whole time required for this last transformation is a minute or less. The length of its preparatory life is variously estimated, the weather having a powerful influence—a month is considered quite sufficient. Three or four days to mature the eggs, fourteen or eighteen for the larval stage, and five to seven for the pupal. But Prof. Riley, says: "Their delevopment is rapid and with one species at least it has been ascertained that the entire life-round from egg to adult is undergone in less than two weeks."

As soon as they have got their wings they make for the thickest vegetable shade within reach. It is said that they will fly for miles inland, but never fly far over water. We read of travellers on the South American rivers, that they prefer to pass the night in their small boats anchored out on the river, rather than attempt to sleep on shore; willing to run the risk of being devoured by alligators in order to escape the certainty of it by mosquitoes.

Culex pipiens is a frail and delicate creature to be possessed of such a vicious and blood-thirsty disposition. But here it must be stated that the sexes differ in this respect. It is the female only that bites ; she alone is responsible for all the evil reputation which has been attached to the species ; the male has not the power, even if he had the will, whilst her will and power seem to be commensurate.

The mouth parts of the female constitute a wondrously elaborate and complex apparatus, which no verbal description can do justice to. What appears to the naked eye to be a single sting, is composed of no less than seven distinct and separable parts. What is taken for the sting is only the sheath in which the sting rests when not in use. Two of the parts are barbed at the point for cutting the skin. All but the sheath enter two-thirds their full length before they begin drawing the blood, the sheath doubling up under the body of the insect.

The manner in which the mosquito draws up the blood to satisfy its cravings, is probably similar to that by which a butterfly secures the nectar from the flowers. Let us consider the long proboscis as lips, the mouth proper being situated in the head at their base ; when the lips have entered the fluid the muscles around the mouth are contracted ; that produces a cavity which is necessarily a vacuum, the fluid naturally rushes in to fill it. When it is filled the muscles around the mouth relax, a valve at the base of the lips closes and prevents its return, and the fluid is forced down the gullet.

The rapidity with which the mosquito thus pumps up the blood, and the quantity it secures in a given time, may easily be observed by any one curious to know, by allowing one of them to operate on the back of the hand, and watch the filling up of the abdomen. I once clipped the end off the abdomen of one thus situated without disturbing its operation, and it pumped away until a pool of blood that had run through it formed on the back of my hand and began to run off, when I stopped the performance. I had been informed that this could be done before I succeeded in doing it.

No poison gland has yet been found in the mosquito, but the irritation resulting, and often continuing long after the bite is given, has led to the general conviction that poison must be conveyed with it. One writer relates that a drop of clear fluid has been observed at the end of the trunk, whilst Reamur says he saw fluid in the trunk itself. Some contend that this fluid is used for diluting the blood so as to enable it to pass through the extremely fine tube, but the quantity that they produce is so small, as compared with the amount of blood they take, that it could have but little effect in that way ; unless it was endowed with some powerful chemical property. Some have stated that if they are allowed to take all they want, there will be no after irritation, the poison being all removed with the blood taken. But personal experiments in this direction do not confirm the statement.

There is a great diversity in the effect of the mosquito bite on different persons, just as there is in the sting of a bee ; not from any difference in the sting and bite, but from something in the constitution of the individual. The Rev. J. G. Wood tells us of the effect of a single gnat bite on himself, given at the junction of the thumb with the wrist. (It is *culex pipiens* he is speaking of). He says : "The hand swelled up until it looked like a boxing glove, was purple in color where it was not crimson, and it was more than three weeks after the bite was inflicted before I fully recovered the use of my hand." This may be considered a serious case, and if he had received several bites at the same time, some of them about the face, we shall say, there is no saying how much more serious it might have been. I copy the following from a communication by H. Stewart, of North Carolina, dated Nov. 3, 1891, given in *Insect Life*, Vol. 4, p. 277, as illustrative of this point :

"I was interested in reading a recent number of *Insect Life* to the effect that the poison of the mosquito was provocative of insanity. When I was engaged in exploring in the vicinity of the north shore of Lake Superior about twenty-five years ago, I had more than one proof of this fact. One of my men was badly bitten, and seemed to suffer more than any others of the company. He became violently insane and ran off in the woods, and in spite of efforts he eluded pursuit and was never found again. Another man on a different occasion was affected in a similar manner, and was captured with difficulty, after a long chase, in which he exhibited the utmost terror, but after a few days' close confinement in the camp he regained his reason. Afterwards he was so seriously

affected by the poison that he had to be sent home. I have noticed that the poison affected persons differently, causing severe swelling in some, fever in others, pains in the limbs in others, while some were but slightly annoyed. I was myself very little troubled by these pests." Along with that we may place the report given by a German professor, of a Mexican doctor who was attending a lady suffering from inflammation of the brain. She had been unconscious for twelve hours, and gave signs of approaching dissolution. The doctor removed the mosquito net and opened the windows, giving the mosquitoes free access to his patient for two hours, when consciousness returned and the lady given up for lost started on the way to recovery, which is quite a likely thing, as blood-letting would be an excellent method for relieving the congested parts.

We frequently read in the newspapers of people suffering from alarming sores, the result of "a mosquito bite," some of them ending fatally. Thoughtless persons, or those ignorant of the nature of mosquito bites, will persist in rubbing the bitten parts, which only tends to increase the irritation and calls for more rubbing. This, continued, may break the skin, blood-poisoning may then ensue, and, if combined with an unhealthy condition of the system, death may quite likely be the result. I have seen children whose bodies were covered with sores caused by their scratching the mosquito bites.

To those who have not lived in a mosquito infested-district, and have formed their opinions by reading such reports ; it might seem to them that life in such a place would be constant misery, and would expect to find the inhabitants covered with sores and bandages ; but such is not the case. There is unquestionably a kind of inoculation that takes place in those much exposed to the attack, which gives them immunity from any inconvenience after the bite is given. The writer of the article "Mosquito," in the *Encyclopædia Britannica*, says : "Even in Britain the annoyances caused by the gnats—"*culex pipiens*"—is very great, and in marshy districts often unendurable, especially to new comers, for it seems probable that the insects really attack a visitor more furiously than they do the natives of the district, but, on the other hand, the latter may be more indifferent to their assaults." Now, we cannot suppose that the mosquitoes prefer a stranger to a native, or that the native does not feel the bite. It is the consequences that make the difference ; the visitor dreads these, the native does not, as there are none to him, he having been thoroughly inoculated ; the bites may be felt equally by both, although there are some endowed with a greater amount of pachydermatous insensibility than others. It is undoubtedly new-comers to an affected district that suffer the worst, that is, if they have not previously been subjected to the attack. Usually a bite on such a one raises a spot about the diameter of half a pea, hard and whiter than the rest of the skin, with a distinct red dot in the centre, producing an immense desire to rub the spot, which, if indulged, causes various degrees of inflammation and redness, with an increased inclination to rub, lasting for two or three hours with some, but twenty-four or more with others. This sort of thing may have to be endured for the whole of the first summer. After that the bite may be felt just as sharp as before, but no such after discomfort will follow. Hence the apparent indifference of the native, but sufficient numbers would make even him quail before their assault, but, being once clear of them, no further inconvenience is felt by him. This kind of inoculation is vividly illustrated in the case of children going into an infested locality to live ; for the first season every bite leaves its mark conspicuous, but afterwards bites show no more than if they had not been given.

How long the mosquito lives in the mature state, is not known with any degree of certainty. Dr. C. V. Riley says : "So far as we know, our northern mosquitoes pass the winter in the imago state, but in limited numbers." Supposing these hibernators are the parents of the summer crop, they might in this latitude begin depositing their eggs—of which they lay about 300—in the beginning of May, and allowing a month between egg and imago, we see that by midsummer the number, under favorable circumstances, would be great. But the question to settle is, how long does the female live in summer before depositing her eggs ? for we cannot suppose that, contrary to the nature of other insects she lives long afterwards ; unless she does not lay them all at once. When one visits a piece of woods situated a long way from stagnant water every few days, and finds an un-

limited supply kept up for weeks, or even months together, it does not seem to favor an early demise. Another interesting question in this connection is, are these hibernating females fertilized before winter sets in, or do the males live over also?

It is the prevailing opinion that mosquitoes live exclusively on animal blood, and yet, probably, not one in a million of them ever gets a taste of it. It is not reasonable to suppose that the life, even of the mosquito, can be sustained long without food of some sort. Several reports have been made from time to time of a vegetable-feeding species of mosquito having been seen. Is it a separate species, or is it our old acquaintance *Culex pipiens* indulging in a little of her natural vegetable diet? I once saw a mosquito on the smooth bark of an aspen poplar, seemingly engaged in an effort to extract something out of it, but with very limited success, so far as the appearance of the abdomen indicated, yet it went through all the movements required to make the success complete. If they will attack the hard bark of a tree, how much more likely is it that they would try the soft stems of succulent plants. When we understand that this is one of the habits of the insect, we see that there is a double reason present why they should seek the cover of rank vegetation, one protection from the direct rays of the sun, which they cannot endure; the other, that they may obtain food to sustain life, Yet, no matter what amount of vegetable juice they may take, it never slacks their thirst for blood. This the unfortunate collector well knows to his cost, when he has been allured in the pursuit of some attractive specimens, to the stirring up of a tall and luxuriant clump of weeds in a damp and shady place.

Many remedies have been suggested for relieving the irritation produced by mosquito bites. The Rev. Mr. Wood says arnica saved him from a vast amount of torture. A wash of ammonia is said by others to give immediate relief.

To rid the house of their presence in the evening, so as to get peaceful rest at night, all are familiar either by observation or report, with the use of smoke. Indeed, the primitive "Smudge" was the only method available in new settlements; but now we have a more clean, convenient and efficacious material to use for the same purpose in insect-powder, "pyrethrum." Make a little pyramid of the powder about an inch an a half in diameter at the base, on some incombustible material, and ignite it at the top. It will consume slowly, producing smoke enough to fill a large room, which will kill or stupify every mosquito in it.

I copy the following from *Insect Life*, Vol. V., p. 359: "The *Indian Medical Journal* for March 16th says that a Bombay newspaper calls attention to the virtues of the castor oil plant as a means of protection against mosquitoes. In Egypt it is planted about houses to drive the insects away. In towns a better plan is to have the growing plants in pots, and bring them into the house for a day or two at a time, but they must not be kept too long in the shade, for *Palma Christi* is a sun-loving plant. A writer is cited as saying that the mosquitoes are killed by a poison they find on the lower side of the leaf, but it is stated that if a dozen leaves are placed about a room that swarms with mosquitoes they will disappear without leaving any dead ones lying about." But vigorous efforts should be made in all mosquito-infested localities to reduce as much as possible the opportunity for their breeding. Stagnant water is well-known to be the principle source whence comes the mosquito plague. This, then, should be got rid of as soon as possible. When this cannot be done at once it should be treated with a little coal oil, which will put an effectual stop to their propagation as has been demonstrated by Mr. L. O. Howard's experiment, published in the last Annual Report of the Society, and thus an immense amount of suffering will be saved to man and beast.

CANADIAN UROCERIDÆ

(Abstract of a Paper presented to the Royal Society of Canada.)

BY W. HAGUE HARRINGTON, OTTAWA.

The paper which I have the honour to submit is, from its length and the number of descriptions contained in it, not suitable to be read in full. I have, therefore, made a short abstract from its contents, to indicate its scope and purposes. It treats of the Uroceridæ, a family of the order Hymenoptera; the species of which are lignivorous in the larval state and attack our forest, shade and fruit trees.

In discussing these insects I have accepted the name Uroceridæ in accordance with the classification of North American Hymenoptera published by Mr. E. T. Cresson, who for many years has been a diligent student of the order, and who has described a large proportion of the American species. In agreement with European nomenclature, the name Siricidæ would be used, as the first species described were placed by Linnæus in Sirex, one of the ten genera into which he divided all the Hymenoptera. His simple classification has been so expanded, to receive the vast number of insects since described, that the Hymenoptera of America, north of Mexico, are separated into about a thousand genera.

The genera placed by Cresson in the family Uroceridæ have been the subject of much discussion by systematic entomologists and their relations to one another and to the Tenthredinidæ, have been variously viewed. The object of this paper is not, however, to discuss the systematic position of the genera, but to bring together for the benefit of students of the Canadian fauna, the descriptions of the various species, and to add such information regarding them as my observations have furnished. No new species are described, but I have rather endeavored to show where the present number of species could be lessened, and the suppressed be placed as varieties. The insects of this family vary very much in size and sometimes in coloration, and several of the species being widely distributed and rare, have been redescribed from different regions.

There are five genera: Cephus, Xiphydria, Urocerus, Tremex and Oryssus. To facilitate the identification of specimens, I have prepared synoptic tables based upon such features as seem most distinctive. The individuals of Cephus appear to be very rare in Canada, but six species are represented, including *C. pygmæus*, Linn., which has been introduced from Europe, where it is well known, and at times a destructive borer in the stems of wheat. In Xiphydria several species have been described, but some are only varieties. The most common species is *X. albicornis*, Harris, which is frequently found on maples, and which does considerable injury to shade trees. I have given observations upon its habits, in the publications of the Entomological Society of Ontario.

The typical genus Urocerus (Sirex) contains about twenty American species of which nearly all occur in Canada. Some of these are large, handsome insects, widely distributed throughout the Dominion; from Nova Scotia to Vancouver Island and very far northward. The larvæ of these insects are borers in our coniferous trees and their distribution is probably co-extensive with the trees they infest. In some sections, pine, spruce, fir, etc., suffer considerably from their attacks. The three most common species are *U. albicornis*, black, with white banded legs and antennæ; *U. flavicornis*, black, with yellow bands and antennæ, and *U. cyaneus*, blue, with ferruginous legs.

Tremex contains only one species, the well-known *T. columba*, the larvæ of which are popularly known as Horn-tails, a name also applied sometimes to the adult insects on account of their long ovipositors. This insect attacks chiefly the maple and beech, which are often thoroughly riddled by its larvæ, but it also infests other forest trees, such as oak and sycamore, and fruit-trees, as apple and pear. It is a striking insect in appearance; one of the largest of our Hymenoptera; richly marked with black and yellow, and provided with a long, stout ovipositor for penetrating the thick bark of the trees in which it deposits its eggs.

The genus Oryssus differs in many important characters from the preceding, and the insects have a very different appearance. They are short and cylindrical in form ; black, or with the abdomen partially red ; have the antennæ short and geniculated, and in their movements they are extremely alert and active. Four species have been on the American lists, but observations which I have made on these insects for several years have convinced me that they all belong to one species. The larvæ live in maples (and possibly in other trees) but it is not known whether they live upon the substance of the tree, or are parasitic upon other wood-boring insects.

For a satisfactory knowledge of the habits of our Uroceridæ, it will be necessary for our entomologists to devote much close attention to the several species. Unfortunately the order Hymenoptera has not at present many students, although both from the scientific and economic standpoints there are many reasons why it should be thoroughly investigated. The late Abbé Provancher, whose scientific labors, especially in Entomology, gained for him a membership, which, unhappily he did not long live to enjoy, in your honorable Society, was a zealous worker in this Order, and he described very many of the Canadian species. His death was a great loss to the study of Entomology in Canada, but it is to be hoped that his collections, which contain the types of so many species, may be placed where they will be carefully preserved and accessible to future investigators.

ADDITIONAL NOTES ON JAPANESE INSECTS.

By W. Hague Harrington, Ottawa.

On my return in November, 1891, from a visit to Japan, I prepared for the annual meeting, held a few days later, a hasty outline of my impressions of the insect fauna of that country. My captures have since been mounted and arranged, and the number of genera and species ascertained, although time has not yet been found to determine the names of the insects. My stay in Japan lasted only ten weeks, and this time was largely occupied in travelling and sightseeing, so that I had few opportunities for systematic collecting, and many of my most interesting specimens were accidental captures. The wealth of the insect fauna is evident, from the fact that under such conditions. and after the most prolific season had passed, six hundred species were taken, Coleoptera constituting one-half, Hymenoptera one-fourth, and miscellaneous insects the remaining fourth. The majority of the specimens were obtained in the vicinity of Yokohama, Hakone and Nikko, which are all situated in the central portion of the Empire Adding to my own captures some Coleoptera received from my brothers residing in Yokohama, I find my little collection to be composed as follows·

Coleoptera	350	Species.
Hymenoptera	160	"
Hemiptera	75	"
Diptera	30	"
Orthoptera	20	"
Lepidoptera	10	"
Neuroptera	10	"
Total	655	

The last four orders are too scantily represented to be compared with those of our fauna, and even the Hemiptera are scarcely numerous enough to afford a basis of comparison.

The Coleoptera and Hymenoptera, however, seem to warrant a few remarks, as a supplement to my former very imperfect paper, and I have therefore prepared tables showing the number of genera and species in the families represented in these orders.

COLEOPTERA.

Families.	Genera.	Species.	Families.	Genera.	Species.
1 Cicindelidæ	1	6	19 Cleridæ	1	1
2 Carabidæ	24	39	20 Lucanidæ	6	9
3 Dytiscidæ	3	7	21 Scarabæidæ	21	44
4 Hydrophilidæ	4	4	22 Spondylidæ	1	1
5 Silphidæ	5	8	23 Cerambycidæ	21	25
6 Staphylinidæ	9	10	24 Chrysomelidæ	33	63
7 Coccinellidæ	11	17	25 Bruchidæ	1	5
8 Endomychidæ	3	4	26 Tenebrionidæ	8	12
9 Cucujidæ	1	2	27 Cistelidæ	1	1
10 Mycetophagidæ	1	1	28 Lagriidæ	1	1
11 Dermestidæ	1	1	29 Anthicidæ	3	4
12 Nitidulidæ	3	3	30 Meloidæ	2	3
13 Trogositidæ	2	2	31 Rhynchitidæ	4	11
14 Derodontidæ	1	1	32 Attelabidæ	2	5
15 Elateridæ	8	13	33 Otiorhynchidæ	10	13
16 Throscidæ?	1	1	34 Curculionidæ	12	18
17 Buprestidæ	5	7	35 Calandridæ	2	2
18 Lampyridæ	3	3	Undetermined	7	7
			Total	222	354

About seventy-five per cent. of the genera occur in Canada, and while probably not more than half a dozen species are common to the two countries, there is on the whole a striking similarity of form and ornamentation, with a sprinkling of conspicuously exotic looking individuals. One such species is found in the Cicindelidæ (*C. chinensis* var?) which was abundant on the Usui Toge, about one hundred miles northward from Yokohama, and still more so at Chofu, near the straits of Shimenoseki, several hundred miles southward. This beetle is very gaily coloured and appears very brilliant when flying or running in the sunlight.

In Carabidæ the striking genus Damaster is represented by two species (probably *D. pandarus*, and *D blaptoides*), from Chofu and Yokohama. There is a very fine Carabus, and among species closely resembling American forms may be mentioned two of Scarites, a Panageus, a Dromius, and four or five of Chlænius. Water beetles were not searched for, but among the few obtained are three fine species of Cybister and a Hydrophilus more robust in form than our *H. triangularis*. Staphylinidæ were not numerous, although the few species represented apparently furnish one which occurs in Canada, viz., *Oxyteles fuscipenne*, which flew into our chamber at Nikko one damp evening in great numbers, and a species more like *O. rugosus*, of which one specimen only was taken. Although the Histeridæ are not represented in my collection, I captured on Enoshima (island famous for glass sponges, shells and marine curiosities) a species much larger than any of the American forms known to me, but the specimen was afterwards lost.

One of the coasting steamers upon which we spent a day or two, swarmed with *Silvanus surinamensis*, and afforded also another cosmopolitan species, *Necrobia ruficollis*. A few specimens of Derodontus beaten from foliage at Yokohama, are perhaps identical with *D. trisignata*, which occurs in British Columbia. A curious Trogositid of a bronzy colour, with two yellow tubercles on each elytron, might from its size and sculpture be readily mistaken at first sight for a Buprestid near Chrysobothris. The splendid buprestid *Chrysochroa fulgidissima*, brilliant green with purple stripes on thorax and elytra, is not uncommon in the forest regions of Nikko and Hakone, and is said to infest several trees, including the Keaki (*Zelkowa Keaki*) which furnishes very valuable timber. There is also a smaller Chrysochroa, more subdued in colour, but still a very handsome insect, which appears to be less abundant. From the mountainous province of Shinshiu (famous for its silk-worms) I have two examples of a fine Chalcophora, much like *C. fortis* in sculpture, but larger.

The family Lucanidæ (Stag-beetles) affords several fine species, which quite overshadow the Canadian representatives of this family, while species of Scarabæidæ are both numerous and attractive, the most remarkable being the colossal *Xylotrupes dichomotomus*, of which the male has a long bifurcated horn on the head, and a shorter cleft one on the thorax. This fine species is apparently common in some districts, and good specimens can be obtained for three or four *sen*. At Hakone I obtained a living male, and at Yokohama picked up a dead female upon one of the Bluff streets. Several species of Anomala, Strigoderma, Euryomia, etc., were very abundant and did immense damage to various crops and to trees and shrubs. The most brilliant beetle of this family is a magnificent Geotrupes, of which I found several on the path from Hakone to Atami. Some of the Cetoninæ, however, vie with it in splendor and are perhaps more beautiful. I have not at hand *Spondylis upiformis* with which to compare the Japanese species, but it is very like the European *S. buprestoides*, with the costæ of elytra more elevated and the punctuation somewhat less dense.

The Cerambycidæ are very fine, and this family shows less resemblance to our fauna than perhaps any other, while still containing some familiar genera. A common species in the coniferous forests, and which I took upon pines on Fuji, is a glossy black beetle with white markings (*Melanauster Chinensis*, var, *macularia*), about the size and shape of our large pine-borer (*Monohammus confusor*). An allied species also from the forest at foot of Fuji, is *Apalimna liturata*, Bate, prettily marbled with grey and black, and with antennæ three inches long.

The profusion of vegetation naturally leads to a rapid increase of leaf-eating forms, and the Chrysomelidæ are correspondingly well represented in species and individuals, exceeding in these respects as well as in number of genera all the other families represented in my collection. While many of the species are pretty and of considerable interest, none are remarkably large or conspicuously colored. Other families are poorly represented until we come to the Rhyncophora, when numerous interesting forms are found. Rynchitidæ and Attelabidæ seem especially numerous in comparison with Canadian species, while Otiorhynchidæ and Curculionidæ have each some large and curious species, although the genera closely resemble our own. The pine woods yielded some fine species of Hylobius and closely allied genera.

Hymenoptera.

The members of this order have a more homelike look than the beetles, and very few genera occurred which are not represented with us, as will be seen by the following list of the genera and number of species in each family :

I. *Tenthredinidæ*,—Hylotoma 6, Cladius 1, Nematus 1, Harpiphorus 2, Aneugmenus 2, Athalia 3, Allantus 1, Macrophya 1, Tenthredo 1, Taxonus 2, Strongylogaster 1,

II. *Cynipidae*,—Aspicera 1.

III. *Ichneumonidæ*,—Ichneumon 8, Amblyteles 1, Trogus 2, Hemiteles 2, Ophion 1, Thyreodon 1, Anomalon 1, Campoplex 2, Paniscus 2, Limneria 1, Mesoleptus 1, Tryphon 1, Theronia 1, Pimpla 3, Glypta 1, Genus near Glypta 1, Lampronota 2, unplaced 2.

IV. *Braconidae*,—Bracon 1, Rhogas 1, Orgilus 1, Phylax 2, Apanteles 1, unplaced 1.

V. *Chalcididæ*,—Chalcis 2, Stomatocera 1, Lelaps 1, Eurytoma 3, Tetrastichus 2.

VI. *Proctotrypidæ*,—Proctotrypes 1, Goniozus 1, Sparasion 1, Macrotelia 1.

VII. *Chrysididæ*,—Chryis 1.

VIII. *Formicidæ*,—Camponotus 1, Formica 2.

IX. *Myrmicidæ*,—Myrmica 2.

X. *Mutillidæ*,—Sphærophthalmia 1, Chyphotes 1, Myrmosa 1.

XI. *Scoliidæ*,—Tiphia 3, Scolia 2, Dielis 4.

XII. *Pompilidæ*,—Pompilus 5, Priocnemis 1, Planiceps 1, Agenia 2.

XIII. *Sphecidæ*,—Ammophila 6, Spex 1.

XIV. *Larridæ*,—Lyroda 1, Larra 3.

XV. *Philanthidæ*,—Cerceris 3.

XVI. *Pemphredonidæ*,—Cemonus 1.

XVII. *Crabronidæ*,—Crabro 1.

XVIII. *Eumenidæ*,—Eumenis 4, Odynerus 4.

XIX. *Vespidæ*,—Vespa 3, Polistes 4.

XX. *Andrenidæ*,—Parasphecodes 1, Halictus 7, Andrena 5, Nomia 1.

XXI. *Apidæ*,—Cœlioxys 1, Megachile 3, Lithurgus 1, Ceratina 2, Synhalonia 1, Xylocopa 1, Bombus 5, Apis 1.

In all there are eighty-two genera represented by 162 species. The Saw-flies number twenty-one species, but are exceeded by the Ichneumons with thirty-three species, including several fine forms. The Ophion has chitinous spots in the sub-marginal cell as in *O. purgatum*, and the Thyreodon is identical in colour with *T. morio*, but is more coarsely sculptured. The two Chalcis are *C. minuta*, Linn. (a cosmopolitan insect), and *C. mikado* a handsomer species which was not rare on lawn shrubberies. Ants were seldom collected, so that the few specimens taken give no indication of the abundance in which these insects occurred at some places. The species of Tiphia and Dielis were very abundant, the former on umbelliferous plants at Hakone, the latter on lawns. One Pompilus seems identical with our *P. biguttatus* and the others much resemble American species. The species of Odynerus are larger than ours, and several individuals were found to be stylopized. Two of the wasps are very large and build immense nests, while Polistes were very abundant, building their nests in shrubberies. Among the bees is a very large Lithurgus, which apparently used the leaves of Wisteria for its nests, and a Bombus which seems identical with *B. lapidarius* of Europe.

NOTES AND QUERIES.

By Rev. W. J. Holland, Ph. D., Allegheny, Pa.

I have just received a specimen of a *Erebus odora*, which was captured last Wednesday evening in the lecture room of the First United Presbyterian Church in the City of Allegheny, where its appearance caused no little consternation among the devout "Mothers in Israel," who were at prayer meeting, and who thought it was a bat, of which evil things are said by the unsophisticated. It is a male in good case. This is the third specimen I have received this summer. The first was taken about four weeks ago in the cellar of my father's residence in Bartholomew County, Indiana. The second was taken at Jeannette, Pa., near a spring house. All three specimens are fresh in appearance, as if not long from the chrysalis. Undoubtedly this great moth is more than an occasional visitor from the tropics, and should be reckoned as belonging to our fauna, though scarce. Its capture has been recorded north of the Ohio and Potomac many scores of times, and it has been taken repeatedly in Canada.

Papilio Cresphontes, Fig. 26, for the first time, has been taken this summer in the neighborhood of Pittsburg and in considerable numbers. One collector obtained four specimens in one locality. The food-plant is Zanthoxylum and Ptelea in these parts. In Florida its larva is abundant upon the orange and lemon trees.

One of the commonest of our Papilios is *Philenor*, Fig. 27. Here its larva is found upon Aristolochia. In southern Indiana, in Bartholomew County, I have observed it summer after summer, sometimes in immense numbers. It is one of the commonest butterflies there as here. But, with the exception of one or two specimens of Aristolochia growing about verandahs in the Village of Hope, I think I may safely say there is not a plant of Aristolochia within many miles of the fields in which I have counted the perfect insect by the score. What is the other plant upon which the larva feeds? It runs in my mind that I have read that the caterpillar has been found upon the smart-weed (*Polygonum hydropiper*) but I cannot recall where I have seen this statement made. I have never been able to verify it by observation. Perhaps some reader of the *Canadian Entomologist* may be able to throw light upon the subject.

The banana merchants in our town have proved themselves possessed of curious entomological stores. I have received from them a couple of living tarantulas, and not long ago a living specimen of *Caligo Teucer*, which had emerged from a Chrysalis, hidden

FIG. 26.

in a bunch of bananas. The insect had been transported by sea and land from either Honduras or some port in the northern portion of South America, a journey of several thousand miles. This reminds me that in several consignments of eastern lepidoptera I

FIG. 27.

have found one Danais plexippus, Linn. One of the sendings was from Borneo, the other from Java. We shall soon hear of its domestication on the mainland of Asia, and it will probably spread all over China and Japan. The insects taken by the U. S. Eclipse

Expedition of 1889, at the Azores, numbered among them two specimens of the butterfly. There were only about a dozen specimens of insects taken at the Azores by the industrious (?) naturalists of the party, and I judge that it must be common there. Why we have not yet heard of its domiciliation on the African continent is a mystery to me. It will, no doubt, get there before long.

I have a specimen of Limenitis taken in Warren County, Pa., this summer, which is most remarkable. It has all the markings of L.ursula, but both the primaries and secondaries are crossed by very broad white bands as in L. Arthemis. It is, however, larger than any specimen of Arthemis I have ever seen, and exceeds the majority of L. Ursula in size. It has the white spots in the cell of the primaries, which appear in some female specimens of L. Weidemeyeri. It is altogether a queer beast combining the characteristics of three of our species. No doubt they all sprang from a common ancestry, and this specimen reveals the force of atavism.

THE DRAGON-FLY.

By T. J. MacLaughlin, Ottawa.

As Economic Entomology has become so important a subject to the farmer, fruit-grower, gardener, and others, and as all insects are now regarded as either noxious or beneficial, a few words in reference to the Dragon-fly might not, perhaps, be without interest, and might assist those who may not be conversant with its habits in assigning it a proper place in the field of economy.

The dragon-fly family—*Odonata*—belongs to the order *Pseudo* (or false) *Neuroptera*. That is to say, to that order of mandibulate insects having four membranaceous reticulate wings, and which undergo an incomplete *metamorphosis* or transformation.

The family is divided into three tribes: *Agrionina*, *Aeschnina*, and *Libellulina* and these again into sub-divisions.

The first tribe, *Agrionina*, embraces all the smaller forms—commonly called hammer-heads—and some of the most beautiful of the whole family, such as the different species of Calopteryx, as the name implies. *C. maculata*, *C. virginica*, *C. æquabilis*, etc.

The wings of all the species of this genus are densely reticulate, broad at, or near, the apex, or tip, and very narrow at the base, with many anticubital veins, and the pterostigma wanting in the males; the color of the wings varies according to the species—jet black, brown, hyaline, semi-transparent and clouded; and the head, thorax and abdomen are of a light green or blue. From their erratic course, the color and comparatively slow motions of their wings, and habit of alighting so frequently, they are readily mistaken for butterflies. They proceed from and spend their life along swift running waters, especially such streams as flow through woods or shaded places; while the other insects of the same tribe—the Agrions, etc., proceed from and frequent only stagnant pools, or the borders of very sluggish streams. This tribe is composed of two sub-families and two legions, with many genera, sub-genera and species, all presenting the same peculiarities—slow, graceful flight and delicate constitutions. The noiseless, gentle movements of these pretty little objects (and they are sometimes found together in vast numbers) dressed in many colors, is truly a picture of combined beauty, ease and contentment, rarely seen. Thousands of the small creatures might float through the air about the ears of the beholder and not a sound could be heard to indicate their presence. They show their affection for each other in the most impassionate and gentle manner; the male, with the little forceps at the extremity of his abdomen, clasps the female gently about the neck, and in this way they fly away on their hymeneal wanderings in the same slow and careless manner which characterizes their movements when flying alone.

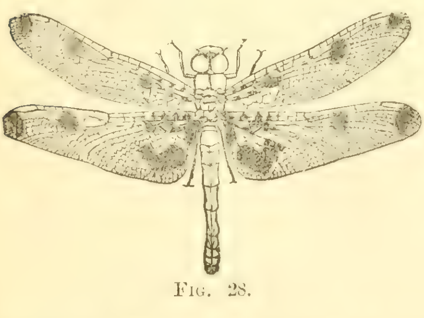

Fig. 28.

Tribe II., *Aeschnina.* This tribe is sub-divided into two families: *Gomphina* and *Aeschnina.* The latter contains the largest and most repulsive of the dragon-flies. The head is large; the eyes are connected from near the labrum, or upper lip, to the upper part of the head and cover both sides down to the jaws, or mandibles. The mandibles are large and powerful and the thorax is of immense proportions. The abdomen is long and slender, and upon capture the insect will coil and slash it about, which always gives the capturer the impression that it is feeling for a place to sting. The wings are broad and strong, and have little of the colors which beautify those of the other tribes. *Aeschna heros* is the largest of the species; it measures about 3½ inches in length, including the appendages, and the expansion of the wings is about 4 inches. The insects of the first tribe—Agrionina—fly low and are seldom seen far away from their natural haunts, but nearly all the species of Aeschnina are high fliers and are met with everywhere, in the woods, fields, on the tops of mountains and in the valleys, continually searching for food; devouring every soft-bodied insect which crosses their path, and looking for more.

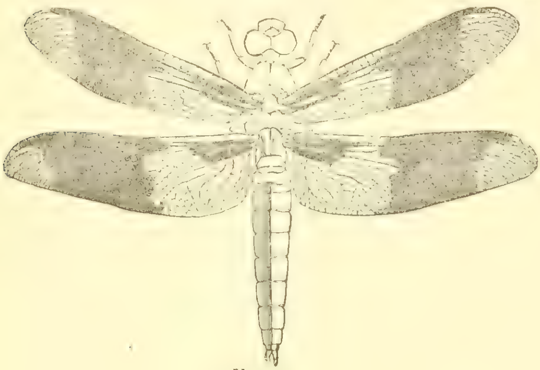

Fig. 29

Fig. 30.

Tribe III., *Libellulina.* This tribe is divided, like the preceding, into two sub-families, Cordulina and Libellulina. The Canadian genera are Macromia, Epitheca, Cordulia, Plathemis, Libellula (Fig. 29, *L, trimaculata*), Diplax (Fig. 28, *D. Elisa*: Fig. 30, *D. Berenice* male; Fig. 31, *D. Berenice*, female), and Nannophya (Fig. 32, *N. Bella*). The prettiest of all our large dragon-flies belong to this division. They are less repulsive and voracious than those of Aeschna, and the wings of most of the species are beauti-

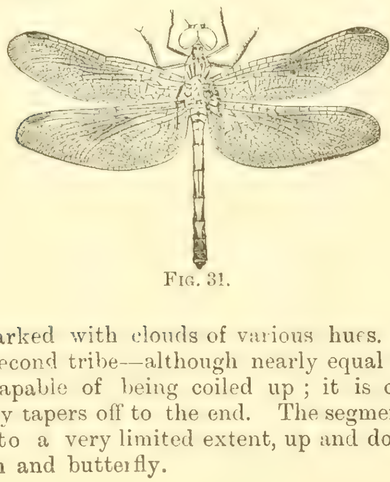

Fig. 31.

Fig. 32.

fully marked with clouds of various hues. They are readily distinguished from those of the second tribe—although nearly equal in size—by the abdomen alone; this member is not capable of being coiled up; it is comparatively short, stout at the base, and gradually tapers off to the end. The segments are joined closely together and the whole moves, to a very limited extent, up and down on the first segment, after the fashion of the moth and butterfly.

With this short and very imperfect description of the three tribes in the perfect, or winged state, something may now be said with regard to the earlier stages of their existence. Dragon-flies are then wholly aquatic animals and are carnivorous in all their stages. The parent fly lays her eggs in the water; some drop the eggs in while flying over the water; others submerge the abdomen and glue the eggs to reeds or sticks, while certain species go below the surface several inches for the same purpose. It is not definitely known how long the eggs are in hatching, nor the length of time the young remain in their larval and pupal states, but the water period of existence is variously stated to be from one to three years, the time varying according to the species. It is known, however, that they all feed upon other aquatic forms of animal life, to a large extent upon the larvæ of the mosquito, etc. The larva (Fig. 33, left hand), can only be distinguished from the pupa (Fig. 33, right hand), by the latter having wing pads, the insect being equally active in both stages. When the pupæ are ready for transformation they crawl out of the water upon the stems and branches of plants, secure a firm hold and remain until the skin is dried, which then

FIG. 33.

splits on the back and the perfect insect comes slowly forth, leaving the hull or pupa case clinging to the plant. Many of these may be seen long afterwards in the same position on reeds and grasses, along the borders of streams, ponds, etc. After coming from these a short time is required to dry and expand the wings; then away flies this beautiful creature, with gauzy wings of many colors, which, but a few moments before, was a horrible, repulsive, voracious object, crawling over the slimy bottom of a filthy pool of stagnant water. Some of the larger species of these insects are very sluggish in their larval state, and on this account nature has endowed them with a very remarkable weapon (Fig. 33 left), which enables them to capture their prey in this and their pupal state, as readily as they can afterwards do upon the wing; it consists in a prolongation of the under lip, which is very long and shaped like a ladle, the end terminating with two in curved hooks or mandibles. When the insect is at rest this elongated lip is folded and concealed beneath the under jaw until some luckless creature comes within striking distance, when out slips this trap-like apparatus (against which its victim has made no provision) and secures the booty.

With regard to their manner of breathing, Duncan, in his work on the transformation of insects, says: "The larvæ and nymphs, although living under water and must respire, have no external organs by which they can breathe. Their method of respiration

is unique ; they breathe with their intestines. The large intestine is covered with numerous tracheæ, and when the animal wishes to breathe it opens the orifice of the intestine and admits a quantity of water. This, of course, contains air mechanically suspended which is taken up by the tracheæ just mentioned." In expelling the water just taken into the intestine, it is sent out with considerable force, which propels the animal forward with a jerk, several times the length of its own body ; by this means it keeps out of the way of its enemies.

Dragon-flies are the most harmless creatures in existence, utterly incapable of injuring man or beast, but, on the contrary, highly beneficial in all stages, inasmuch as they are the natural enemies of the mosquitoes, house-flies, moths, and other noxious insects, which would abound in greater numbers and interfere much more seriously with our comfort and our products than they do under the continuous and effective check of the dragon-fly. Yet, strange to say, these insects are not known by five-tenths of the people of Canada, and most of those who know them by name are not acquainted with their habits, but—to quote from a previous article on the subject—" Avoid or destroy them on account of the mistaken impression which some people have as to the poisonous effect of their sting, or the childish tradition as to their habit of sewing up the eyes and then stinging their victim to death." Others admire them for their beautiful colour, slender forms and graceful motions.

They are known by various names and epithets, such as : Devil's darning-needles, mosquito-hawks, horse-stingers and some others in English. The Germans call them Wasser-jung-fern, or virgins of the water. The Indian knows them by the name of Kow-ne-she, or Duch-kow-ne-she, and the French are pleased to style them Demoiselles. The last does not seem so appropriate as some of the other appellations, as the points in which any of these creatures resembles a lady, are not clearly defined, unless it be in their slender waists. I know that some of the large ants are called Demoiselles by the French, and their delicate forms rather suggest the name, but with all their admiration for the beauty and modesty of women, I agree with Duncan when he says : "No Frenchman would think of comparing a dragon-fly with a lady, if the nature of this animal was known." In this part of Canada dragon-flies begin to issue from their pupa cases about the midlle of May, the first appearing are those of the genus *Libellula*, and by the 10th of June all the different species may be found on the wing. After the middle of September they gradually disappear, but some of the hardy species, such as *Diplax hudsonica* and *Aeschna verticalis* and *venosa*, may be seen well on in November, apparently as vigorous as they were on starting out, and hungry enough to devour the elements.

It is interesting to know that even at this late date the Odonata is beginning to assert its personality, and the services so long rendered by this family of insects are now being observed, acknowledged and appreciated, not only by naturalists, but by many who do not pretend to make a study of the subject, as the following will show : A few years ago, while engaged in building the Lake Superior and Mississippi Railway, Dr. R. H. Lamborn, of New York City, had occasion to make frequent excursions, in the capacity of director and treasurer of the company, through the swampy forests around the head of the great lake, and his experience with the mosquito and other troublesome flies of that region was so impressive that he determined to array his own with all other natural forces against them. Having observed the activity of the dragon fly in the destruction of the mosquito, and also having witnessed an entomologist feeding a dragon fly that had eaten thirty house-flies in rapid succession, without lessening its voracity, the thought came to him that the artifical multiplication of the dragon fly might accomplish a mitigation of the mosquito and house-fly pests. He accordingly sought among entomological works for some account of experiments tending to throw some light upon the subject, but without the desired result. Finding that science had left those investigations almost untouched, and that there was nothing in the known life history of the dragon-fly that would enable him to form an opinion as to the possible success of such an undertaking, he addressed letters to Dr. Uhler, of Baltimore, the highest American authority in the great class of insects to which the dragon-fly belongs, and Rev. Dr. McCook, another naturalist of high standing, and having received the greatest encouragement from both of those gentlemen,

as to the importance and possible practicability of his scheme, Dr. Lamborn at once placed $200 in the hands of M. K. Jesup, president of the American Museum of Natural History, New York, to be paid by him in three prizes of $150, $30 and $20 for the three best essays based on original observations and experiments on the destruction of mosquitoes and flies *by other insects*; the prizes to be awarded by Dr. H. C. McCook, Vice-President of the Academy of Natural Science, Philadelphia, and Dr. J. S. Newberry, President of the New York Academy of Science. A circular was accordingly prepared in July, 1889, and sent to the working entomologists of the country, embodying the conditions and the object of the contest. The time given to respond was five months. It is not stated how many took part in the contest, but at the end of the time given, awards were made as follows: first prize to a lady, Mrs. C. B. Aaron, of Philadelphia, and the second and third equally divided between Mr. A. C. Weeks and Mr. Wm. Beutenmüller, both of New York City.

These three essays, with nine plates showing several species of dragon-flies, house-flies and mosquitoes in the various stages of development and the different devices suggested for the extermination of the mosquito, along with bibliographical lists of the authors quoted and literature on the subject, an article by Dr. H C. McCook, and a letter from Capt. Macaulay, were published by D. Appleton & Company, New York, under the title of "Dragon-flies *vs.* Mosquitoes," in a handsomely bound octavo vol. of 200 pages.

Mrs. Aaron's experiment with petroleum is so interesting and valuable that we feel constrained to make the following quotation. On page 63 she says: "The United States Department of Entomology and the various State reports, as well as numerous entomologists abroad have long recommended the use of petroleum in some form for the extermination of plant lice and many other noxious insects. Petroleum emulsion, sprayed petroleum, the naphtha compounds and others from the same source, are prompt and deadly insecticides. With this in mind, we early began a series of tests with common illuminating oil on culicid *larvæ* under all circumstances. The narration of one series of experiments, typical of all, will illustrate the efficacy of this treatment. In a shallow pool of water with an area of ten square inches, five pupæ, two grown larvæ and about six others in various stages of development, were put, with them, also two immature Odonata, and a number of Cyclops and Cypris. On the surface ten drops of oil were placed and were observed to cover the whole area in ten minutes. At once great uneasiness was manifested by the larger larvæ. Then they all began cleaning off the breathing tube with their jaws, with apparent discomfort. The evident effect of the oil was to coalesce the cilia at the tip of the tube, thus making respiration difficult or impossible The annoyance, fear, agony and finally desperate frenzy, were clearly depicted by their actions. The two grown larvæ were dead in eight minutes; several of the half-grown died in ten minutes; at the end of twelve minutes most of the remainder, save the very smallest had succumbed. The pupæ had both expired in fifteen minutes. In an hour and a half everything was dead except the Odonata and minute crustaceans; the former seemed to be in in perfect condition owing to their multitudinous breathing appliances. After the oil had been put on the above area, it was at once seen that the proportion was too great. A second pool of the same dimensions was tried with one drop of oil which was quite enough to have the same deadly effect, though the results were not so rapidly attained. The all-pervading nature of the oil was shown by the fact that one of the larvæ removed to a pool of eight square inches of surface took enough oil with it to cause almost intense uneasiness to the inhabitants of the otherwise fresh water.

These experiments were tried time after time, always with the same result, and show conclusively to us that oil is the great hope of nearly every mosquito infested district, for the following reasons: (1) Its cheapness; (2) its deadly nature when applied to the culicidæ; (3) its comparatively harmless nature as applied to other forms of aquatic life; and (4) the ease with which it can be applied.

It is obvious that the time allotted was far too short to admit of much original observation or experiments along the lines of the scheme which brought forth the call for the contest. Had the time been two years instead of five months and the prize correspondingly great, the results would have been much more important and the conclusions

perhaps very different. As it was the essayists—not having had time to prosecute experiments in the artificial culture of the Odonata, were obliged to draw conclusions from what had been done by others in that way (which was almost nothing) or from their own imagination—without data, both as to the possibilities of artificial multiplication of the dragon-fly and the effect that such would have on the mosquito and house-fly.

Time will not permit giving even a short account of the other essays; suffice it to say, all the important scientific knowledge on the subject up to the year 1890 has been reproduced in concise and accurate form, and it must be admitted—even if nothing more is done as a result of this initial step—that the collection of all the scientific knowledge on the subject in an easily accessible form is well worth the time and outlay; and it is not too much to say that Dr. Lamborn has not only assumed a neglected function of the state and thus shown the Government an example in this philanthropic movement, but he has placed science and humanity under an obligation.

Sufficient has been produced to show that the dragon-fly is the most beneficial insect at least in the order to which it belongs, and deserving of a foremost rank among the insect friends of man.

THE SONG OF THYREONOTUS.

By William T. Davis, Staten Island, N. Y.

Mr. Samuel H. Scudder, in the Report of the Ontario Entomological Society for 1892, gives an interesting account of the "Songs of Our Grasshoppers and Crickets," and kindly permits the stridulations of a number of Staten Island insects to be heard mid the general medley. There is, however, an addition songster to be added to this list, as appears from the following.

On the 26th of last June I heard in a moist pasture, on the north shore of the Island, a stridulation that was unknown to me. It much resembled that produced by *Orchelimum vulgare*, with the preliminary zip, zip, omitted. It was a continuous *z e e e*, with an occasional short *ik*, caused by the insect getting its wing-covers ready for action after a period of silence. It was too early for *Orchelimum vulgare* by about a week; at least I have never heard one on the Island before the fourth of July; so in the present instance I made careful search for the musician. In due time I discovered, in a tussock of rank swamp grass, the brown songster perched on a dead leaf, and receiving the evidently welcome rays from the afternoon sun. It was *Thyreonotus pachymerus*, and in the swampy field about me I heard others of its kind, so that this individual was only one of a considerable colony.

A failure to make proper use of his legs (the wings are abortive) resulted in the transfer of Thyreonotus from the tussock to a tin can. At home I made a bowery for him in a larger tin can covered with netting, into which was introduced a branch of the coriaceous leaved post oak, and when the leaves dried, there were innumerable nooks and crannies wherein to hide. Usually, however, the insect did not hide at all, but perched himself on one of the topmost leaves and there waved his antennæ after the manner of all long-horned Orthoptera. Starting with raspberries, he had the rest of the fruits in their season, including watermelon, of which he showed marked appreciation. If I offered him a raspberry, and then gradually drew it away, he would follow in the direction of the departing fruit and would finally eat it from my hand.

As the bowery was kept in my bed room, I had the full benefit of the songs of its occupant, and was often awakened in the night by his sudden, alarm-like outburst of melody. He stridulated with unabated zeal to the first of August, when I noticed that his energies were lagging—he seemed to be much less sprightly. Finally his song, instead of filling the room, was but a faint sound, and I was obliged to place my ear close to the tin can. This was nearing the end, which came either on the tenth or eleventh of September, I cannot say which, for the bowery was not disturbed until its occupant had been missing from the upper leaves for several days.

Once or twice during his captivity he took unnecessary alarm at my well-meant efforts to "fix" the bowery, and whacked his head most insanely against the tin can, being propelled thereto by his muscular hind legs. However, no harm seemed to result from these little fits of nervousness, and he evidently died quietly enough in the end.

I have observed in other kinds of grasshoppers the subsidence in the volume of song as they grew older, which evidently makes it unsafe to take the efforts of a single individual as the standard of the species, especially if the time is late in the fall.

NOTES ON SOME OF THE MORE IMPORTANT ENTOMOLOGICAL EXHIBITS AT THE CHICAGO EXHIBITION.

By James Fletcher, Ottawa.

There was much for the economic entomologist to see and learn at the wonderful exhibition, which has recently closed at Chicago. The beautifully arranged and comprehensive exhibit made by the Division of Entomology of the United States Department of Agriculture was alone worth a visit to Chicago to see. A full catalogue of this collection has been published by Prof. Riley, and every economic entomologist should endeavor to obtain a copy of this instructive work while it is available. As it has been distributed in large numbers to the many interested visitors it is not expedient to more than draw attention here to some of the most striking features. The interest manifested in the exhibit by the constant crowds around the cases must have been very gratifying to those who conceived and carried out so excellently this invaluable object lesson of the utility of applied entomology.

Conspicuous objects on entering the court were wax models of a full-sized cotton plant, a plant of Indian corn and a species of Golden rod. These models were most accurate and realistic, and were shown as representatives of a new line of entomological illustration. The first two were chosen as being important and characteristic economic plants of North America, the Golden Rod as being one of the conspicuous and widespread floral forms which add beauty to our autumn scenery and which is very attractive to insects. Beneath these models were systematically arranged all the insects known to injure or frequent the plants.

There were 129 distinct enemies of the corn plant represented; these were arranged according to the nature of their injuries, i. e., as affecting the root, stalk, leaves or ears. The different stages were shown, and references to the literature were given as well as the best remedy. Around the hill of ripening cotton were arranged 37 species of insects. The model of the Golden rod showed the large number of insects which visit the plants of this genus either to feed on the different parts or attracted by the nectar of the flowers. Near these exhibits were enormous models of some of the best known crop pests, such as the Hop-plant Louse, the Chinch bug, the Australian Fluted Scale and its chief enemy, the Lady-bird, *Vedalia cardinalis*, which has done such good work of late years in controlling this pest not only in Australia, but in California where it has been introduced by Prof. Riley. Some anatomical models representing the Silkworm, Honey bee and Cockchafer were also exhibited. An interesting collection of silk insects showed the more important native and foreign Lepidoptera producing cocoons of commercial value. What was styled a "professional exhibit" displayed the apparatus used in collecting, rearing, mounting and preserving insects.

Of special interest to the economic entomologist and farmer were the insecticides, and the spraying and other implements for their application. There were about eighty samples of insecticides, and among other things a full collection of the various kinds of spraying nozzles, the working of which was shown and explained by an assistant in charge. Around the walls was arranged a collection of illustrations of insects and other objects which have from time to time appeared under the entomologist's direction.

The section of systematic and biologic entomology consisted of a great number of cases showing different orders of insects which were not exhibited as a "complete series, but as samples taken from the actual collection to illustrate the methods employed in the arrangement of the regular systematic and biologic series, and also to give the visiting entomologist an insight into the present state of the national collection."

A collection of great interest was one prepared under Prof. Riley's direction by Prof. J. B. Smith, and was intended to illustrate all the families of insects found in North and South America. Every known family of insects on this side of the world is indicated in it. This collection is unique. It was intended as a synopsis of the families of American insects illustrated by the specimens themselves or drawings—in almost all cases the families are represented by specimens. The labels are all in Prof. Smith's handwriting, and together with the arrangement bear witness to the labour and care expended on them.

The next collection calling for mention was the collective exhibit of the agricultural colleges and experiment stations. This was made up of contributions from the entomologists of some of the State experiment stations, and showed great variety in the methods adopted and the excellence of the work. There were, of course, features of interest in all, but some were so far superior to others that they at once drew the attention of the visitor. Prof. Harvey, of Maine, sent five beautifully neat cases, illustrating by means of specimens and coloured drawings the work of the Apple Maggot. Prof. Hopkins, of West Virginia, provided fifteen cases of forest insects, which were put up very neatly with printed labels and good specimens of insects and their work. One case was devoted to parasites. Prof. J. B. Smith contributed an extensive collection, showing in ten cases the insects of the cranberry, grape, blackberry, sweet potato and squash. These were put up with Prof. Smith's usual care and labelled in a legible manner, which unfortunately could not be said for all the collections. One collection particularly, of eight cases of neatly arranged biological material, lost much in appearance from bearing large labels in ugly back-hand writing.

At first sight Prof. Smith's cases seemed too much crowded with specimens, but this was done intentionally to draw more attention, as he maintains that farmers for whom, after all, this sort of collection is prepared, will frequently fail to recognize a species if only one or two specimens are shown him ; but, where, as for instance in the cranberry *Teras*, he is used to seeing swarms of them flying on the bog, a series of from twenty to thirty appeals to him at once, and he recognizes the insect. For the same reason large specimens of insect injury were introduced. A farmer is involuntarily attracted to a large specimen and to a striking injury. His eye is caught by seeing what was apparently a large vigorous plant badly damaged. The object is to give one seeking for information plenty to look at and abundant opportunity to examine the specimens. There is also another feature. If an insect is represented by only two or three specimens and perhaps one or two larvæ, it conveys the impression that these insects are rather rare, that it is difficult to get specimens. The object is to convey the idea that the insects shown are abundant and that they are to be respected from the point of the numbers in which they occur, if not on account of the size of the individuals.

In the exhibit of apparatus for entomology there are three more cases from the same station, showing insects injurious to Indian corn ; the apple, pear and quince ; and one of the Wheat louse and its enemies. These were meant to illustrate the manner of preserving all kinds of specimens and as a sample of the collection of an experiment station. No effort was made to have these complete—that would be impossible in the space—they were rather as a suggestion how a thing should be done than as an exposition of the subjects themselves.

Near the above mentioned cases was a sample of the Cornell case, in which everything is arranged on a separate block so as to facilitate removal if necessary. Without knowing the advantages claimed for this arrangement, it must be acknowledged, I think, that the general effect is less tidy than the ordinary method. There were collections from Prof. Bruner, of Nebraska, showing enemies of the sugar beet, several cases from Prof. Osborn, of Iowa, and six very neatly arranged cases of apple insects, together with coloured drawings of their work, prepared by Prof. Popenoe, of Kansas.

In connection with the agricultural exhibits of some of the States were several collections of insects. Minnesota showed specimens of Coleoptera, Lepidoptera, the bee moth, and injurious locusts, all well mounted and arranged. Several colleges and schools also made exhibits. The most important of these was that made by the Illinois State Laboratory of Natural History, under the direction of Prof. S. A. Forbes. This was a most instructive, well arranged and well prepared display. It illustrated the methods of work and lines of study pursued. Fronting on the main aisle was an office fitted for entomological work, such as might be occupied by an entomologist and two assistants, one for office and one for field work, and an amanuensis, showing arrangement of tables and cases, all supplied with the necessary apparatus and reagents. Examples of the library, library catalogue, collections of all classes of material, records with their indexes and methods of keeping notes, also appeared here. A full set of the publications of the State laboratory and State entomologist's office were here displayed. The size of this room was twenty by twenty-seven feet. At the back of this office was a small section of an insectary, fitted with breeding cages for all kinds of insect life, sand tables, various insectary supplies and apparatus for experimentation and study in the contagious diseases of insects. This measured eleven by twenty feet. On the outside of the enclosure just described, and in adjoining cases are ranged the collections illustrating the various lines of work pursued at the State laboratory. The economic work is represented by four collections, one shows the insects injurious to the apple in all stages as far as obtainable, to the number of 176 species. It may be mentioned *en passant* that Dr. Lintner has now on record the names of 282 species of insects injurious to the apple. The second collection showed the injurious insects of corn in the same way, numbering 149 species; the third, those of wheat, fifty-seven in number, and the fourth, those of the strawberry plant, fifty species. The more minute forms are accompanied by exquisite water colour sketches, the work of the laboratory artist, Miss Lydia M. Hart, showing their appearance when magnified. The boxes are fifteen and a quarter by eighteen inches, and two and a half deep within. The front and back of glass, the sides of wood separable into two halves along the middle of the sides. The back is lined with sheet cork attached to the glass by a wax mixture, the cork covered with paper of neutral olive tint, which greatly enhances the appearance of the specimens. Half-sized boxes are used where the space requires it. Studies on the foods of animals were represented by three collections. A most remarkable exhibit which drew much attention was that of the average food of a robin during the part of the year that that bird is in Illinois, as determined by percentages obtained from the study of 114 stomachs of these birds taken at all times and seasons. The quantity as well as the kind of each element is shown, and illustrates well the difficulty which sometimes meets one in determining whether a certain bird or animal should be considered beneficial or injurious. Eleven full-sized boxes are used; they contain 5,481 pinned specimens and 111 tubes of alcoholic material, mostly eighteen inches long, which is the full length of the box. Eleven of these tubes exhibit the vegetable elements of the food. A collection of insects found in the food of birds contains 195 species, and one of those found in the food of fishes includes ninety-one species. The insect fauna of the State is illustrated in two collections, the common insects of the State numbering 1,578 species, occupying sixty-nine cases. In nine boxes is shown the geographical distribution of the commoner Illinois butterflies, those occurring throughout the State, those peculiar to Southern, Central and Northern Illinois; those found also in Europe, in the Atlantic States, and in the Pacific States are separately grouped. A collection of 459 species of pinned insects is exhibited, which is one of forty collections lately made and distributed to high schools of Illinois which were in need of them.

Several collections of more or less interest were exhibited from foreign countries. Most of these were unnamed, consequently of no value for reference. Russia and Germany showed grand collections of forest insects. Canada was represented by a collection of about twenty cases prepared by myself, with the assistance of several members of the Entomological Society of Ontario, who kindly contributed specimens. The moths, filling eight cases, were arranged by Mr. J. Alston Moffat, and two cases of Hymenoptera by Mr. W. Hague Harrington. The collection of Diurnal Lepidoptera was probably one of

the most complete in Canadian species which has ever been brought together. When this collection is returned, it will become the nucleus of a collection at the Central Experimental Farm at Ottawa.

THE FIFTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.*

The fifth annual meeting of the Association of Economic Entomologists was held at Madison, Wisconsin, in the Science Hall of the University of Wisconsin, on August 14, 15 and 16, 1893.

Sixteen members were present, as follows: President, S. A. Forbes; Second Vice-President, J. B. Smith; Secretary, H. Garman; J. M. Aldrich, G. F. Atkinson, G. C. Davis, C. P. Gillette, A. D. Hopkins, L. O. Howard, M. E. Murtfeldt, H. Osborn, C. V. Riley, P. H. Rolfs, H. E. Summers, F. M. Webster and H. E. Weed A number of visitors and members of other scientific associations were present during the sessions, making rather a large attendance.

The following papers were presented, among them several from foreign entomologists, and the discussions were of the greatest interest.

The annual address of President S. A. Forbes reviewed the 115 economic articles containing new matter published by members of the association since the last meeting. These articles he grouped by subjects and by nature of outcome, thus giving an admirable idea of the work of the year in shape for the drawing of conclusions. He called attention to a narrowness of view and consequent inadequacy in the treatment of general questions, due to the want of comprehensive organization and systematic co operation. In his opinion the methods of publication and enforcement of results now in general use, fall far short of their final end. As a result the farmer has not responded to the suggestions of the investigating entomologist as might be anticipated. He suggested that more attention might be paid to describing the effects of insect work than to the insects themselves, subordinating the account of the insects. He insisted that instead of making an entomologist of the farmer we should make a farmer of the entomologist. He suggested distinguishing between the temporary and permanent presentation of facts in economic publications, advising the preparation of special economic summaries or monographs of all insects injuries to each of the various crops, and printing and distributing these summaries in great numbers. Co-operation in this particular line was urged. Addresses to Farmers' Institutes should be accompanied by a printed résumé to be distributed among those present.

"But now," to quote the language of the address, "supposing full and accurate information widely disseminated and in the actual possession of those for whom it is especially designed, we have next the most difficult task of all; to make sure that it will be practically applied. What shall we do and what advise to secure a common action in accordance with known and admitted facts? Shall we leave this to the individual and to the coercion of neighborhood opinion, or, these failing, shall we look to the law and to agencies established under the law? In short, are we practically individualists or socialists in our leanings? The official entomologist, I need hardly say, need not shrink from the word socialism, for as a Government official he is himself a socialistic product; as much so as the experiment station or the public school. Without attempting here to debate so large a question, I venture to express my own opinion that we should look to the law and to some regularly established system of inspection and penalty enforced by law to supplement the spontaneous agencies of society where these fail to protect the industrious and intelligent against the destructive consequences of neglect on the part of the idle and the

*Through the kindness of Mr. L. O. Howard, of the Division of Entomology, Department of Agriculture, Washington, D.C., who has furnished us with an abstract of the official minutes and also proofs of the full report, prepared for *Insect Life*, we are enabled to give this account of the meeting, together with some of the most generally interesting papers.—Ed.

ignorant. There are regions—those parts of my own State worst infested by the Chinch Bug, for example—where there seems really to be no choice between legal compulsion on the one hand and the slow and enormously expensive operation of the law of natural selection on the the other. Either the slow processes of social and economic revolution must be allowed to take their destructive course, carrying down too often the bright and willing farmer with the hopelessly sluggish mossbacks all around him, who breed insects by the bushel to devour his crops with their own, or we must have a State or county board, acting in conference with the official entomologist, empowered to recommend a protective proceedure in cases which are clear beyond all reasonable controversy and to assign penalties for a failure to conform. I would, myself, advise both State and county boards—perhaps those agricultural boards already existing—on the ground that it is useless to attempt to enforce measures, however plainly necessary, against the common sentiment of the locality."

He then spoke of the fact that the boundaries of the State represented by official entomologists are artificial, and that in consequence matters of distribution and other broad questions are seldom touched. This fact and the danger of unnecessary duplication of work, and other reasons, called for organization, and this organization should be of flexible form, leaving each individual free to meet the special requirements of his individual work, and at the same time helping to concentrate the surplus effort which should be contributed to the accomplishment of common ends. He suggested that a committee on co-operation propose a list of subjects in which co-operative effort is desirable. These subjects should then be attacked by volunteers, who should report to the committe. In this way, he thought, that the benefits of organization might be obtained without the surrender of individual initiative.

The address was discussed by Messrs. Osborn, Smith and Webster. Mr. Osborn thought that laws requiring farmers to destroy insect pests appearing on their farms could be made effective, and gave the operation of the Canada thistle law in Iowa as an example. He thought that such laws should apply in all cases only to such pests for which good remedies could be recommended The Fall Web-worm could, he thought, be easily controlled in his State if everyone was required to destroy it whenever it appeared on his place.

Mr. Smith spoke of the difficulty of inducing many farmers to take any precautions in checking the injuries of insects, and thought that laws requiring them to give attention to such matters could not be enforced. The weed law of New Jersey was mentioned as an example of the ineffective working of such laws. He was of the opinion also that the number of laws required, if one were made for each pest, would be a difficulty not easily surmounted, since it was not easy to get legislators to pass such laws.

Mr. Forbes thought a community which would not enforce laws relating to farm pests must be left to suffer, but he had known instances where public opinion on these matters was such as to compel farmers to give them attention.

Messrs. Osborn, Smith and Garman were appointed a committee of three to consider the recommendations contained in the address.

Messrs. Edward H. Thompson, of Tasmania, R. Allan Wight, of New Zealand, and G. C. Davis, of Agricultural College, Michigan, were elected to membership.

Mr. Osborn presented a paper entitled "Methods of Treating Insects Affecting Grasses and Forage plants." In this paper he considered the insects affecting these crops by groups arranged according to the method of treatment, discussing particularly climatic conditions, natural enemies, agricultural methods, and the direct method. He presented a most interesting table of insects, showing in horizontal columns the food plants, number of annual broods and the condition in which the species is to be found during any month in the year, and closed with the following practical recommendations:

"(1) A general rotation of crops, especially for clover and for meadows generally, and change at the end of four or five years at the most.

"(2) Where it is desirable to keep the same field continually in grass or for a long series of years, as in rough land or woodland pastures, attention to the maintenance of trap lights, the use of arsenical baits or applications, burning, and the tar pan should be practiced, especially after the second year.

"(3) To allow ground squirrels, moles, and other natural enemies to carry on their work unmolested, and in case their multiplication affects surrounding crops to adopt means of protecting such crops without destroying these animals. If in localities where fertilizers may be used with profit, to adopt the use of such kinds as nay have insecticidal properties."

The paper was discussed by Mr. Hopkins.

The next paper, by Mr. Howard, was entitled "Notes on Methods of Studying the Life-histories of Injurious Insects," in which he described the vivarium methods in use in the Division of Entomology of the U. S. Department of Agriculture, but insisted that out-door work is preferable where feasible. The question of methods of ventilation of the insectary and kindred topics were discussed by Messrs. Forbes, Garman and Howard. Mr. Forbes thought that in-door work on life-histories should always be verified by out-door observation.

Under the caption, "Another Mosquito Experiment," Mr. Howard detailed as follows his experience, with the use of kerosene on the surface of mosquito-breeding pools, since his announcement of his first experiment a year ago.

ANOTHER MOSQUITO EXPERIMENT.

By L. O. Howard, Washington, D.C.

Just as "one swallow does not make a summer," one experiment does not fully satisfy the economic entomologist of the value of a remedy. At the last meeting of this association I laid before you the facts concerning an experiment in applying kerosene oil to the surface of a mosquito-breeding pool and argued from its results that in many localities where the breeding places are circumscribed, the mosquito plague may be largely averted.

The publication of this paper excited considerable interest in the subject and brought me some little correspondence from individuals who considered themselves advantageously located for the testing of the remedy on a larger scale than I had been able to attempt. Dr. Wooster Beach, of New York City, wrote last fall that it appeared to him quite possible to treat large tracks of land in the manner proposed, and solicited Government aid in locating breeding places in Westchester County along Long Island Sound, provided he could interest property holders and raise a small fund to be expended in the purchase of kerosene and the wages of men to apply it under expert supervision. The necessary aid was promised him, with Dr. Riley's sanction, and he made a strong effort to arouse the popular interest by articles in the local papers ; but either through nonsusceptibility to mosquito poison on the part of his neighbors, or through indifference arising from other causes, he failed to collect the fund, and an interesting experiment on a large scale was thwarted.

Another very satisfactory experiment upon a small scale, however, has been made the present season. But before recounting the facts in the case I must advert to the chronic disinclination on the part of the property holders of a given neighborhood to admit that they are troubled by mosquitoes. I spoke in *Insect Life* last fall of a New Jersey mosquito remedy, recounting the killing by its means of seventy-five mosquitoes on the ceiling of my room in a New Jersey town, the name of which I thoughtlessly published. By the next mail, after the issue had reached that part of the country, I received letters from two residents of the town warning me that I would be mobbed by the inhabitants if I ever set foot in the place again, that is, provided my note should happen to be re-published in some more widely read journal than *Insect Life.* New Jersey and mosquitoes had been coupled in my mind since earliest boyhood, and I was totally unprepared to learn that our cultivated and refined neighbors were sensitive on the point.

However, after this experience I was not surprised to find that the gentleman who conducted the experiment which I am about to detail, desired his name, and particularly his locality, to be kept from the public eye. I may state, however, that it is within two hours' ride from the City of Washington, and that I have had an opportunity to verify the condition of affairs as reported to me.

The gentleman in question had seen in one of the newspapers some account of my Catskill Mountain experiments and wrote to me through a mutal friend in Washington for detailed advice in his own case. Correspondence elicited the fact that the mosquito supply must come from a small mill pond one-eighth of a mile from his house, from a small, marshy track above the pond, and from two horse troughs, one at his barn and the other at the roadside in front of his house. He had also a large rain-water barrel for which he immediately had a cover constructed at my advice.

The horse troughs were readily freed from "wrigglers" by using a small fine-meshed hand net every few days, and the kerosene treatment was used for the mill pond and the marsh. Estimating the surface area of the pond at 4,000 feet, he sprinkled on it 15 gallons of the cheapest kerosene. This formed a continuous layer, and remained evident to the senses, in the absence of rain, for two weeks. Three weeks after the application, which was made on the 4th of June, I visited the place and found that the kerosene was still operative, although a slight shower had fallen on the 17th day. No trace of a living aquatic larva of any kind could be found, and the surface of the pond was thickly strewn with dead aerial insects, among them many female mosquitoes.

A few straggling living mosquitoes were noticed about the house the first week in June, but none subsequently, and although the treatment was not repeated, none have been reported to have appeared during July.

The small marsh pools above the dam were treated at the same time, two gallons of kerosene being used for this purpose. The ensuing drought, however, dried these pools up thoroughly and vitiated the experiment. The total expense of the treatment was $1.70 plus two hours light labor for two men, and the result was immunity from mosquitoes for the household and vicinity.

This is a typical case of those which I had in mind when I expressed last year the opinion that there must be many localities where, by use of these simple remedies, the mosquito plague may be averted.

It may be well to add I had the pleasure of receiving, in May last, a note from Dr. Robert H. Lamborn, the donor of the mosquito essay prizes of two years ago, in which he says: "Your exact observation regarding the treatment of insect-breeding waters with petroleum is most useful and it seems to me to be new." I trust it is understood that no novelty is claimed for the idea, but that I have simply recorded these experiences as showing conclusively that the remedy is not a theoretical but a practical one.

Mr. Smith had known of two recent cases of the use of coal oil for destroying mosquitoes on Long Island, and stated that the results supported Mr. Howard's claims for the method.

Mr. Webster thought that the matter needed more experiment; that there was a prevalent opinion that mosquito larvæ in ponds appropriated a good deal of organic matter that would otherwise become offensive, and by destroying them it was possible to do harm instead of good.

The Secretary read a paper by Dr. Ritsema Bos. on "*Phytomyza affinis* Fall. as a Cause of Decay in Clematis." The larva of this little fly he had found to produce a disease spot on the stem a little above the level of the ground, causing the subsequent drying up of the stem. He found two generations of the fly each year, and advised the cutting off and burning of decaying stalks in early summer. Messrs. Hopkins and Garman reported similiar appearances in potato stalks and the terminal twigs of apple, which were probably due to a closely allied insect.

FARM PRACTICE AND FERTILIZERS AS INSECTICIDES.

By John B. Smith, Sc.D., New Brunswick, N. J.

It is safe, I think, to assume that every economic entomologist has been at times woefully disappointed at the outcome of what seemed the most promising experiments. Most of us have learned by sad experience that because a poison, or one used as such, acts well in one instance we can not be at all certain that it will act equally well in another. Many of us have run across insects that seem to eat all our usual insecticides with perfect impunity, or upon whom they act so slowly that they are practically of no effect. I have in mind at present, from my own experience, the Rose chafer, *Macrodactylus subspinosus* (Fig. 34) of which many farmers claim, from experiment, that the arsenites do not injure it. I am not quite ready to agree to this, but I am certain that they act so slowly as to be useless.

Fig. 34.

Frequently we find insects whose life habits are such that we cannot reach them with insecticides, even if we have such as would readily kill them. Of such a nature is the "Boll" or "Corn worm," the larva of *Heliothis armiger*, which in tomatoes lives in the fruit, and in corn lives in the ear: in both cases safe from any application we can make. We have next a series of forms which in their injurious stage live in the soil itself and feed upon the roots of our crops. In cases such as I have mentioned our battery of poison is of little or no avail, because there is no proper opportnity to make use of it. We must adopt other tactics and, if possible, use preventive measures. These may be either positive, as where we cover a tree trunk with a substance mechanically protecting it from injury; or they may be more indirect, as when we change a crop, or plant late, or early, to avoid the period at which injury is done. This latter means of prevention is one which, in my opinion, is worthy of the closest attention and consideration on the part of entomologists. Not the mere planting early or late, but the question of so arranging farm practice as to avoid insect injury to the important crop. Insects have a life history which in the vast majority of cases is practically invariable. There is, usually, a fairly well-marked date of appearance, a tolerably defined period of adult life, and a normal period of development. The first and most important problem to be solved is the exact life history of the injurious species. That done, before the matter of insecticides is to be considered at all, the question should be: Can we avoid trouble or injury by modifying our practice without impairing quantity, quality, or price of crop? In many more cases then is usually believed a mere change of time will avoid injury. I do not claim any originality in this suggestion, and need only instance the fact that by a proper attention to the date of sowing, damage from the Hessian fly may be avoided.

Rotation of crops, if intelligently practised, will frequently prevent trouble when insecticides are out of the question. Our fellow member, Mr. Webster, applied this principle in dealing with the *Diabrotica longicornis*, easily controlling what threatened at one time to become a very serious pest. Trap crops, planted principally to save the more important staple, are often available. For instance a full crop of late squashes may be obtained, free from the borer, *Melittia ceto*, if summer squashes are first planted and the Hubbards and Marrowfats somewhat delayed. The summer squashes will attract the vastly greatest percentage of moths to oviposition, and these may be removed after getting an early crop, filled with the larvæ that would otherwise have attacked the later vines. The proposition to use corn as a trap crop to prevent injury from the Boll worm to cotton has been forcibly urged by Mr. Mally in a recent bulletin from Dr. Riley's office. Methods of cultivation are frequently of use—as for instances in squashes again, where borers attack the vines near the roots. In fertile soil the joints may be covered at intervals and roots will be formed at every such joint sufficient to mature the fruit, even if entirely cut off from the original base of supplies. I have mentioned only a few instances to illustrate the suggestions made, and make no claim to originality so far as the principles involved are concerned. All have been applied by no means as often as they might have been, but

more often by far than the cases cited by me. The importance of fall plowing to destroy forms hibernating in the soil is not even suspected by many of our farmers, but need not be dwelt upon here.

In one other way much may be done to check many forms of destructive insect life—the scientific application of chemical manures, or fertilizers.

In the older States the natural fertility of the soil has long been exhausted, and it is necessary to supply the necessary plant food in some form. The traditional fertilizer is barnyard manure, and to this a very large proportion of the farmers cling as the only true material. Scientific experiments and investigations have shown that the necessary elements of plant food can be as well or better furnished in the shape of inorganic substances, and that they possess in many directions points of superiority over the traditional barnyard manure. In New Jersey the use of these chemical or "artificial" fertilizers or manures is annually increasing, and many of our best truckers, those that actually make farming pay, use nothing else. Merely as an instance of the result it may be recorded that the finest strawberries shown in Chicago this year were from New Jersey and were grown with chemical fertilizers only.

It occurred to me, some years ago, when I noted that farms where these chemicals were used were unusually free from insects, that they might have insecticide properties that could be very usefully employed. Peach orchards were then suffering quite severely from the *Aphis persicæ-niger*, which sapped the roots, especially of small and nursery trees, and my first experiments were directed to the question of the effect of kainit and muriate of potash on plant lice. I found them sufficiently effective to risk recommending them for use, particularly the kainit. Since that time almost every large grower of peaches in the State has dosed his infested trees with kainit, and I have not yet found an instance of failure where it was intelligently applied. How far stupidity can go is shown by a grower who carefully piled little hills of this material around his nursery trees, to make certain it should all get to the roots. He lost almost every one of his trees, though the application, if broadcasted, would have been considered a moderate one only. Of course the potash acted as a stimulant and supplied needed plant food; but even though part of the improvement was explainable in this way in some cases, yet it really made very little difference so long as the primary object, the destruction of the Aphids, is concerned.

In some sections of New Jersey the Corn Web-worm has become somewhat troublesome of late years, and in this season of 1893 is worse than ever before. I have inquired and examined carefully in a number of cases, and in every case I found that where chemical manures were used injury was insignificant or entirely wanting, while in many other fields in which old methods were employed no stand was obtained after two or even three replantings, and the fields loooked excessively ragged and uneven. In one of the bulletins of the Delaware Experiment Station this fact is quite evidently brought out, though not aimed at in the experiment made. Muriate of potash is less effective than kainit, but has very decided insecticide value. Nitrate of soda ranks close to kainit in effectiveness, and is peculiarly valuable as a fertilizer from the rapidity with which it becomes available as plant food, strengthening and stimulating growth as well as destroying insects. I have had opportunities several times this year to note wire-worm injury on farms treated by chemical fertilizers as compared with those on which the usual routine was followed, and the verdict was always and vastly in favor of the chemical manures. No insects can live for any lengthy time in a soil saturated with these fertilizers, and I have tried all forms that have come under my notice. Mr. Fletcher found white hellebore very effective against the cabbage maggot; tried on a maggot that is found in diseased onions, hellebore was far inferior in its action to kainit or nitrate of potash. Truckers using these materials constantly are a unit in claiming practical exemption from cut-worm injury, which is often very severe on plant crops.

I have no desire to present statistics on this subject; these I will reserve for another occasion; my object will be gained by the few citations that have been made and which are examples of those upon which I base my faith that the intelligent use of fertilizers will be of very great aid in eventually freeing us from the injuries of many troublesome species.

This, combined with other intelligent farm practice will, I think, prove the main reliance of the farmer in future. Insecticides will and must continue to be used in some cases ; but in my opinion they have been sometimes relied upon to the exclusion of more radical measures.

The strength at which a substance proves effective, and its action on the plant, are matters of importance. Two hundred pounds of nitrate of soda and 600 pounds of kainit are not unusually large applications, and calculating this amount to onion rows I found that to make a thorough application I must use the nitrate at the rate of $5\frac{1}{3}$ ounces to 1 gallon of water, and kainit, 1 pound to 1 gallon. I made certain that these were effective insecticide mixtures, and then had one of our leading onion-growers try them over onion rows. They did not injure the plants in the least, either as to leaf or bulb, and as 10-foot rows were treated, injury would have been quickly noticed. Even the tender foliage of the rose will stand a solution of kainit at the rate of 8 ounces in 1 gallon.

As a matter of fact the solutions which come into contact with the insects are often saturated, and much stronger than the mixture given, for if the material is broadcasted or sown in the rows, each drop of water carries with it all that it can dissolve, and as the moisture evaporates, the mixture becomes just as strong as it is possible to be, and of course the insecticide effect is intensified.

I will close by simply referring to the fact that the phospates have no insecticide value so far as my experience has gone—not even the odorless phosphate, which has been put upon the market with the usual nostrum circular claiming that it would kill everything.

This paper was discussed by Messrs. Hopkins and Webster.

Mr. Hopkins thought it was a question as to whether the fertilizers really kill insects, or by giving plants increased vigour enable them to outgrow injures. He had observed in his practice on the farm that the use of stable manure on sod infested with white grubs and wire-worms had the effect or producing a good crop of corn when plowed under, while on adjoining land not fertilized, the attack of these insects was very destructive.

Mr. Webster had no doubt that fertilizers increased the vigor of plants, but thought that Mr. Smith had n t demonstrated that they destroyed or drove away the insects.

The above papers were all read at the first session of the Association on the afternoon of August 14th. At the second session on the morning of the 15th letters were read from certain foreign entomologists regretting their inability to attend the meeting.

Mr. Garman presented a paper on the "Preservation of Larvæ for Study." He drops the larva into water heated to the boiling point, leaving it for 15 seconds. Then, when the body wall is somewhat rigid, he takes it up with the forceps and with a fine sharp scissors cuts a slit along the underside of the body, dropping it into the water for a few seconds longer. It is then transferred to 50 per cent. alcohol and in 12 hours to 70 per cent., and in 12 hours afterwards to 95 per cent. for permanent preservation. Shape, colours and structure are well preserved in this way. As a substitute for alcohol he recommends : boiling water, 250 cc. ; common salt, 3 tea-spoonfuls ; powdered alum, one teaspoonful ; pure carbolic acid, 5 drops ; filter.

Mr. Forbes spoke of the preservation of fruits at the World's Fair and suggested that plants injured by insects may be preserved in the same way. Mr. Summers had found nothing which would satisfactorily preserve fruits. Mr. Osborn thought that aqueous preparations would freeze. Mr. Smith has employed with success methods similar to those of Mr. Garman.

A paper by Mr. Cockerell entitled, "The Distribution of Coccidæ," was read by the Secretary. He compared the Coccidae of the different West India Islands with the adjoining mainland, and spoke of the further distribution of a number of species which he had studied in Jamaica. Of 18 species found on that Island all but 3 are known elsewhere, and 11 have been detected outside of neotropical regions.

Mr. Hopkins presented his views on "Note and Record-keeping for the Economic Entomologist." He described the system which he has worked out and adopted and which

he has proved to be well adapted to the requirements of his work. The system consists of an accession catalogue and a species catalogue. Specimens of his cards or note pads were exhibited, and Messrs Smith, Osborn and Webster discussed the paper,—Mr. Webster giving in full his own system of note-keeping. Messrs. Smith and Osborn objected to the use of check-list numbers alone for species as adopted by Mr. Hopkins.

Mr. Garman's paper on "Illustrations for the Economic Entomologist" was next presented. He considers that the object of illustrations is to convey information and to save time in description, finish and technique, being, therefore, matters of secondary importance. The different methods of reproducing drawings were very carefully and fully discussed. Etching was considered in general impracticable as calling for a special method of drawing. Lithography was considered too expensive and wood-engraving is subject to liability of the engraver to misinterpret certain details of the drawing; but at the same time it was admitted that of our published figures, wood-cuts are the best. In spite of its disadvantages it is the most satisfactory method, although somewhat expensive. Cheap process figures are excellent for newspaper and other transient literature Their right in permanent literature and especially in scientific writings is questionable at the present time. No cheap process known to the writer gives good results in shaded figures. These figures give promise of something better in the near future. If it were not, however, for this hopeful outlook it would be well to return to wood-engraving. Entomologists were urged to make their drawings with extreme care and to adapt them to a particular process and not to rest satisfied with inferior reproduction. The paper was discussed by Messrs. Osborn, Weed, Smith, Hopkins, Gillette, Forbes and Howard

Mr. Gillette read a paper on "The Arsenites and Arsenical Mixtures as Insecticides." The article comprised a general summary, historical and critical, of the use of these substances in their different combinations. The paper was discussed briefly by Messrs. Beal, Wood and Galloway, all of whom were present at the meeting, although not members of the Association.

Upon invitation, Mr. B. T. Galloway, Chief of the Division of Vegetable Pathology, of the U. S. Departmnet of Agriculture, gave a short account of some recent work done in his Division upon a bacterial disease of melons and other cucurbits which had been found to be largely disseminated by the agency of insects, particularly of *Diabrotica vittata* and *D. 12-punctata*. Messrs. Webster, Smith and Garman had seen the same disease in their respective localities.

At the third session, held in the afternoon of August 15th, an amendment to the constitution was adopted, levying annual dues of 50 cents upon each member of the Association, and a resolution was passed authorizing the publication of the whole proceedings in *Insect Life* and the sending of an abstract to the *Canadian Entomologist.*

Messrs. Osborn, Webster and Weed were appointed a committee on nomination of officers. The following paper was then read:

DESTRUCTIVE SCOLYTIDS AND THEIR IMPORTED ENEMY.

By A. D. Hopkins, Morgantown, W. Va.

Within the last three years enough evidence has come under my observation of the destructive powers of Scolytid bark and timber beetles to convince me that they are among the worst enemies of our forest trees. In fact it is my belief that bark and timber beetles have caused the loss of more property, having a commercial value in West Virginia, within the last ten years, than that occasioned by any other single class of insects within the same time.

The destruction of our pine and spruce forests alone, resulting from the primary attack of a single species of bark beetle, has caused, since 1890, the loss of timber having a value of not less than a million and a half dollars.

Certain great devastations in the spruce forests of Maine, New Hampshire, New York, New Brunswick, France and Germany, since 1860, were evidently the work of

bark beetles, which, aided by timber beetles, not only cause the death of trees, but so damage the wood and hasten its decay that the timber soon becomes worthless, and in this country proves almost a total loss.

The destructive species of Scolytids may be divided into two classes, one class, including only a limited number, makes the primary attack, or prefers to enter the bark, roots and wood of living trees and other plants. The other class has a preference for injured, unhealthy, or felled trees, etc., the bark and wood of which these insects infest for the purpose of perpetuating their species. The first is primarily to blame for causing the death of trees, or at least a diseased condition, while the second is responsible for the death of the diseased ones and for causing the premature decay of the wood. All bark and timber beetles are, therefore, more or less destructive in their habits, their power of destruction depending more than anything else perhaps upon their numbers.

Nature has provided plant life with the power, to a certain extent, of resisting the attack of enemies and with natural means of healing wounds, recovering from disease, and other injuries occasioned by severe drought, cold, etc. Therefore, in order for a single species of insect enemy of a tree to attack and kill it, it must not only infest a vital part, but must occur in sufficient numbers to overcome all resistance. This is especially the case with destructive Scolytids, which, to accomplish this end, must enter the bark or wood of living trees, where they meet with the flowing sap, which offers the greatest resistance and is most difficult to overcome. Therefore, no single species of Scolytid bark beetle can cause the death of large or small forest trees unless occurring in immense swarms. In fact, it is doubtful if any single species could overcome the resistance thus offered by vigorous, healthy trees, without the assistance of numerous species of Scolytids and other insects which always come as reënforcements after the first attack is made. Hence, to cause a widespread devastation of timber, numerous species must work in concert. One species makes the primary attack and causes at once an unhealthy condition of the bark and tree. This diseased condition, if ever so slight, attracts other species to the affected tree. One or more kinds will attack the bark and wood at the base, others attack the bark at different points on the trunk, others infest the large and small branches, while still others enter the bark and wood of the terminal twigs, until the infested trees may be the hosts of twenty-five to forty species of Scolytids, each aiding the other in making the conditions favorable for the perpetuation of their species, and all contributing to the death and premature decay of their host.

Thus, through certain favorable conditions (the increased numbers of the species which are capable of existing in the green bark of living trees being the most favorable), an invasion may be started which in a few years results in the loss of millions of dollars worth of property.

The fact that the primary attack of one species makes the conditions favorable for the increase of others, which in turn contribute to the increase of the first, is an important feature to be considered, in our effort to discover methods of checking or preventing the ravages of this class of insects. If the number of those making the primary attack can be reduced below their power of causing a diseased condition of the trees, the trouble of which they are the primary cause must end. If, on the other hand, their undue increase can be prevented, invasions by them can not occur.

Thus, it is evident that, before considering a remedy against an invasion of Scolytids, we must discover the species to blame for the primary attack, and become as familiar as possible with its life history and habits, as well as the life history and habits of other species co-operating with it, and also study other causes which might contribute to or oppose the progress of their destructive work.

In the consideration of preventive measures against invasions of Scolytids, we must study the habits of the different species of the family in order to ascertain which of them are capable of causing diseased conditions of trees, or through increased numbers, their death.

During an investigation of serious trouble caused by these insects in our state, I have given special attention to these subjects. After discovering the species to blame for the

primary attack, and its principal aids in continuing the devastations, methods of checking the increase of the destructive kinds and protecting forests of healthy timber from their invasions were considered.

I was convinced from the first that no artificial remedy, such as cutting and burning the infested trees, the removal of the bark from the trunks, etc., could be successfully applied in our West Virginia forests. Therefore, my attention was turned toward the study of the parasitic and predaceous enemies of Scolytids, with a view of ascertaining the most desirable kinds with which to conduct experiments in utilizing them as a means of checking the increase of the destructive species.

An enemy of Scolytids was desired which would not have to depend on one or two species for its existence, but could readily adapt itself to different species and to varying conditions.

I found that while Scolytid bark beetles have numerous parasitic Chalcid, and Braconid enemies, few, if any of them, in my opinion, can be relied upon as introduced enemies to suppress or prevent an invasion of these beetles. I found, however, among their predaceous enemies, that the habits of certain species of the Coleopterous family Cleridæ were such, if these beetles occurred, or could be introduced in sufficient numbers in the infested forests, this would certainly have the desired effect.

In my search for literature regarding native and European Clerids, I found, in a report upon forestry, by F. B. Hough, 1882 (p. 264) as copied from a special publication of the French Forestry Administra, in connection with the Universal Exposition at Paris, that a European species, *Tillus formicarius*, was mentioned as being a "foe of *Bostrichus typographus* that pursued them without mercy," during an invasion of these bark beetles in the forest of *Abies excelsa* in the Jura mountains, from 1868 to 1872. This led me to make further inquiries in regard to this and other European enemies of Scolytids, and on October 13, 1891, I wrote to my correspondent, Oberfoerster W. Eichhoff, of Strasburg, Germany, asking him to send me some pinned specimens of insects known to be special enemies of European Scolytids. At the same time I indicated to him my desire to introduce live examples of such species as in his judgment would prove beneficial in this country as natural enemies of *Scolytus rugulosus*, *Polygraphus rufipennis*, *Dendroctonus terebrans*, and *Dendroctonus frontalis*. Among the thirty one species of pinned specimens received from him on November 12, he mentioned *Clerus formicarius* as being "beyond a doubt the best destroyer of Scolytids."

On May 30, 1892, I again wrote to Mr. Eichhoff, mentioning the damage to our forests by *Dendroctonus frontalis*, and stated that I was very anxious to try the experiment of introducing *Clerus formicarius* into our forests as an enemy of this and other bark beetles. In his reply of June 26, he referred me to Director C. Schaufuss, of the museum at Meissen, Saxony, as one who could give me efficient aid in this matter. Upon further investigations of the ravages of the bark beetles in our forests, I prepared a special report, dated July 9, which was addressed to the principal owners of the spruce and white pine timber in West Virginia. In the closing paragraph of this report, reference was made to the successful introduction of the Vedalia into California, and the possibility of introducing in a like manner insects from Europe which would feed upon the destructive bark beetle. It was suggested that it might be necessary to make a special trip to France and Germany for this purpose, and that if the timber interests of the State would share in the expenses of such a venture, this object might be speedily accomplished. In reply to this communication six of the principal timber companies of the State responded with liberal contributions, and I was authorized to proceed at once to Europe for the purpose of studying the insect enemies of European Scolytids, and to collect and import to this country such species as in my judgment would prove efficient in checking the ravages of insects in our forests.

In studying the enemies of European Scolytids, I found, as in this country, numerous Hymenopterous and Coleopterous parasitic and predaceous species in company with the Scolytids in the bark of the infested trees, but realizing to the fullest extent the danger of introducing insects into this country which might prove injurious as well as beneficial, I took every precaution in the selection of the species. Out of quite a number of enemies of Scolytids observed and considered, only one, *Clerus formicarius*, was selected, primarily

on account of its being regarded as the greatest destroyer of European bark beetles; secondarily on account of the general opinion of entomologists and forest officials whom I consulted, and my own convictions from a personal study of its habits, that it would not be injurious.

The first examples of this European bark beetle destroyer collected by me were taken in the Hagenau forests of *Pinus sylvestris*, on August 29, in the first tree examined, and they were afterwards found common in the larva, pupa, and imago stages in their pupa cases or winter quarters in the outer bark of large and small trees which had been injured or broken by storm and heavy snow. The bark of these injured trees was infested principally by the common European bark beetles, *Hylesinus* (*Myelophilus*) *minor*, Hart, and *Hylesinus* (*Myelophilus*) *piniperda*, Linn. The larva of the Clerid had evidently been devouring the larvæ and pupæ of the latter species at a fearful rate, for in many instances scarcely one had escaped where there had apparently been thousands. The Clerid was also found under the same conditions in the forests near Meissen in the Kingdom of Saxony, and was taken from the bark of spruce logs in the Lauterbrunnen Valley in Switzerland, where they had been feeding on *Tomicus cembrae*, Heer.

Upon my return to this country, with something over a thousand specimens, a small colony of the beetles and larvæ were placed in a pine woods near Morgantown, on October 10, 1892, being the first examples set free in America. The remainder were successfully kept over winter in the larval and pupal stages, and between April 20 and May 10, they were distributed to the timber companies which had contributed to the expenses. Colonies of 25 to 100 were placed by me, or under my special supervision, on and in the bark of trees, logs and tops, where the conditions were most favorable for their propagation.

Eight importations, numbering 2,082 examples, have since been received from collectors in Alsace and Saxony, Germany, and the living examples have been sent to the timber companies in five different counties, with special instructions for their proper location in colonies in the same manner as first mentioned. In all 26 colonies have been placed in the different sections of our forests. The conditions surrounding each colony are most favorable for the Clerids to thrive and increase, and we have every reason to believe that they will do so under their changed conditions, but as yet we have no means of ascertaining to what extent they have multiplied, and, of course, it is too early to expect results.

There is one interesting fact, however, that I have observed this season regarding the destructive Pine bark-beetle, *Dendroctonus frontalis*, and that is that its numbers have been very greatly reduced since last fall, consequently at this time very little, if any, timber, is dying.

On the 24th of July, 1892, I found this species attacking and mining beneath the bark of living trees, in which they occurred in immense numbers. By the latter part of September a brood had emerged from the bark of the same tree while the leaves were yet green and those that had emerged were entering the bark of other living trees. In November the bark of the same trees were found to be infested by countless thousands of the insects in all stages from eggs to adults. Trees so affected subsequently died, but through persistent search in the bark of such trees in different sections of the State, I have failed, as yet this season, to find a single living example of *Dendroctonus frontalis*. Hence the trouble, as caused by this species, is evidently at an end in West Virgina, for the present at least.

No other species of Scolytids infesting the same trees seem to have been affected by the cause which it would seem has rendered *Dendroctonus frontalis* almost extinct. In fact the great number of trees that died last summer and fall were found last spring to be infested by immense numbers of bark and timber beetles of different species. These have since emerged, and it would seem that the only danger to be apprehended from a continuation of a trouble like that we have mentioned, would be from the attack of some of the species which have thus emerged from the dead trees, for it is evident that unless they find favorable conditions in the felled trees, tops, stumps, etc., in lumbering regions they must either attack and kill living trees or they must perish.

One species, the Turpentine Bark-beetle, *Dendroctonus terebrans*, has already made a desperate effort in this direction. Early in May the adults emerged from the trees in which they had bred, but failed to find dying trees, the bark of which they preferred to in-

fest for the purpose of depositing their eggs. Then followed a remarkable and interesting occurrence, probably never before observed in the life habits of this and other species of Scolytids. They with numerous other members of the Scolytid family, including both bark and timber beetles, must have started, with one accord, in search of more favorable conditions for their propagation, for they occurred in different sections of the State, at about the same time, in great swarms like migrating locusts. Specimens were sent to us accompanied by startling accounts of plagues of bugs that invaded mill yards, furniture shops, newly painted houses, etc. They were reported as coming like a hailstorm against the windows, and in at the open doors like swarms of bees, and that the air on all sides was full of them. During my absence from Morgantown (where our station is located) one of these migrating swarms of Scolytids invaded the town and occurred at certain houses and at furniture factories in such immense numbers that some of the people became alarmed. The report was started that Hopkins' German bugs had devoured all of the pine bugs and were going to prove like the English Sparrow, a universal pest. It was probably well for me that I was absent at the time.

The men were painting a new greenhouse at the station at the time, and the number of the beetles attracted to the building, evidently by the odor of turpentine, was so great that the men were exceedingly annoyed in their work. When I returned to the station, several days after, I found evidence of their numbers in the handfuls of dead beetles that failed to escape from the greenhouse.

Dendroctonus terebrans occurred in by far the greater numbers in these migrating swarms, and when they failed to find dying or injured trees they attacked living Pine of all kinds, Black Spruce and Norway Spruce, entering the bark at the base of the trees. Some of the trees thus attacked in May were examined July 15, and the bark near the point of the attack was found to contain parent adults, eggs, and full-grown larvæ, the larvæ occurring in great numbers surrounded by the flowing turpentine. Trees so attacked were still living, but the injury will probably cause a diseased condition of the trees, which will attract other species and result in their final death, thus we may be on the eve of a new destructive invasion like that which has just passed. Other species, like *Polygraphus rufipennis*, *Tomicus calligraphus*, and *Tomicus cacographus*, which are capable of existing in green, sappy bark, occurred in such abundance in the dying spruce and pine trees last spring that it is evident they must exist in the forests in great numbers, and are ready to attack trees showing the slightest indication of disease or weakened vitality, if they do not make a primary attack.

Therefore, this imported enemy will find abundant food and favorable conditions for its rapid increase in the infested bark of felled trees, tops and stumps in lumbering regions in which or near which the colonies have been placed.

This imported Clerid does not confine itself to one or two species of bark beetles in one kind of trees, but the adults, it would seem, will attack and devour the adults of any species of bark and timber beetles found in the United States, and their larva will feed on the eggs, larvæ, pupæ and young beetles of any species infesting the bark of pine and spruce trees. In fact, they are inclined to make themselves generally obnoxious to the little bark pests.

It would seem that all of the conditions necessary for the imported Clerid to multiply and become an efficient protector of our pine forests from future destructive invasions of bark beetles are most favorable. *Dendroctonus frontalis*, evidently the most destructive enemy of our pine forests, has, from some cause, been reduced far beyond its destructive powers. Other species which have depended upon it for the primary attack are, it would appear, somewhat demoralized on account of the disappearance of their benefactor. The large amount of felled timber found in the several lumbering regions will probably attract the larger portion of other threatening bark beetles away from the green trees, and by the time *Dendroctonus frontalis* can again marshal sufficient forces to successfully attack and kill the trees, they will, it is hoped, be met with a force of enemies led by the European Bark beetle Destroyer, which will successfully repel them and thus save our forests in the future from destructive invasions of bark beetles.

Mr. Smith, in discussing this paper, said that he thought the experiment entered upon in West Virginia well conceived, but thought that parasites did not greatly benefit the farmer. Mr. Hopkins, in reply, stated that it required enormous numbers of the Scolytids to kill the pine trees, and that his idea was to get some means of reducing the numbers of the beetles and not completely exterminate them. That parasites were a benefit to agriculture was, he thought, demonstrated by the irruptions of pests which took place when, by some means, they reached localities from which their parasite was absent.

PARASITIC AND PREDACEOUS INSECTS IN APPLIED ENTOMOLOGY.

By C. V. Riley, Washington, D. C.

The importance to man, and especially to the agriculturist, of the parasitic and predaceous insect enemies of such species as injure vegetation, has been recognized by almost all writers on economic entomology. Indeed, it is a question whether the earlier writers did not attach too much importance to them ; because, while in the abstract they are all essential to keep the plant-feeding species in proper check, and without them these last would unquestionably be far more difficult to manage, yet, in the long run, our worst insect enemies are not materially affected by them, and the cases where we can artificially encourage the multiplication of the beneficial species are relatively few. While fully appreciating the importance of the subject, therefore, it is my purpose in this paper to point out the dangers and disadvantages resulting from false and exaggerated notions upon it.

There are but two methods by which these insect friends of the farmer can be effectually utilized or encouraged, as, for the most part, they perform their work unseen and unheeded by him, and are practically beyond his control. These methods consist in the intelligent protection of those species which already exist in a given locality, and in the introduction of desirable species which do not already exist there.

The first method offers comparatively few opportunities where the husbandman can accomplish much to his advantage. That a knowledge of the characteristics of these natural enemies may, in some instances, be easily given to him, and will, in such instances, prove of material value, will hardly be denied. The oft quoted experience which Dr. Asa Fitch recorded of the man who complained that his rosebushes were more seriously affected with aphides than those of his neighbors, notwithstanding he conscientiously cleaned off all the old parent bugs (he having mistaken the beneficial ladybirds for the parent aphides) may be mentioned in this connection. Other cases will recur to you, and I will mention one rather striking experience related by my assistant, Mr. L. O. Howard. The Army Worm (*Leucania unipuncta*) was overrunning a large and valuable field of timothy and threatened the destruction of the adjoining fields. The insect was as yet, however, circumscribed and susceptible of remedial treatment. The owner of the field, observing the buzzing swarms of the Red-tailed Tachina-fly, assumed that the fly was the parent of the worms, and as the former was an active winged creature, capable of extended flight, he concluded that remedial work was useless, since the flies could, and doubtless would, deposit their eggs over the entire surrounding country. As a consequence the worm was allowed to travel to the adjoining fields and the injury thus increased through ignorance of the fact that the Tachina flies were the most important of the parasitic enemies of the worm. For many years well-informed gardeners in parts of Europe have practised collecting ladybirds and some of the ground beetles to liberate upon plants infested by plant-lice or by cutworms. The characteristics of these two families, Coccinellidæ, and Carabidæ, should be taught in our schools, as a definite knowledge of certain species, which is readily acquired, may often be turned to account in a limited way by the cultivator.

In a few cases like this there is no reason why the farmer should not be taught with advantage to discriminate between his friends and his foes, and to encourage the multiplication of the former ; but for the most part the nicer discriminations as to the bene-

ficial species, some of the most important of which are microscopically small, must be left to the trained entomologist. Few of the men practically engaged in agriculture and horticulture can follow the more or less technical characterizations of these beneficial species, and where the discriminating knowledge is possessed, it can, as just intimated, only exceptionally be turned to practical account. Thus our literature on this subject in the past has been of interest from the entomological rather than from the agricultural point of view, as most writers on economic entomology have contented themselves with describing and illustrating such beneficial species.

In other cases much good may be done without any special knowledge of the beneficial forms, but as a result of a knowledge of a special fact which enables the farmer to materially encourage the multiplication of parasitic species while destroying the plant-feeding host.

The Rascal Leaf-crumpler (*Mineola indiginella Z.*) a common insect which disfigures and does much damage to our apple and other fruit trees, and which hibernates in

Fig. 35.

Fig. 36.

cases attached to twigs, is a case in point. (Fig. 35, *a* and *b*, represents the curious cases made by these worms; *c*, the head of a larva; *d*, the moth. Fig. 36, shows a case covered with a bunch of withered leaves.) Many years ago I urged the importance of preserving the several parasites known to prey upon it, in the following language :*

The orchardist has but to bear in mind that it (the leaf-crumpler) is single brooded and that it passes the winter in its case, and he will understand that by collecting and destroying these cases in the dead of the year when the tree is bare, he effectually puts a stop to its increase. . . . Whether collected in winter or pulled off the trees in spring or summer, these cases should always be thrown into some small vessel and deposited in the centre of a meadow or field away from any fruit trees. Here the worms will wander about a few yards and soon die from exhaustion and want of food, while such of the parasites, hereafter mentioned, as are developed or in the pupa state will mature and eventually fly off. In this manner, as did Spartacus of old, we swell the ranks of our friends while defeating our foes.

The practical value of this suggestion was subsequently fully demonstrated, and especially by the late D. B. Weir, who, at a meeting of the Illinois Horticultural Society, as secretary of a committee appointed by said society to consider the best means of securing co-operation in the warfare against the fruit-growers' insect enemies, announced that this policy had been followed with happy results.

*Fourth Report, Insects of Missouri, 1871, p. 40.

A similar course was urged by me in the case of our common bag-worm (*Thyridopteryx ephemeræformis*) (Fig. 37.) This species, as we know, is also subject to parasites, and the bags or cases which are collected in winter, instead of being burned, should be allowed to remain until the middle of the next summer in some vessel well separated from trees and shrubs, in order that the young worms, when they hatch in spring from the eggs contained in the female bag, may perish, while the parasites develop and escape. Prof. J. H. Comstock has suggested in a similar way the placing of the hand-collected chrysalides of the imported Cabbage-worm (*Pieris rapæ*) in boxes covered with wire netting, in order to admit of the ready escape of the little Chalcid parasite (*Pteromalus puparum*) and at the same time retain such of the butterflies as may issue—a practice which had, I believe, been successfully employed in Europe. Other similar cases of this mode

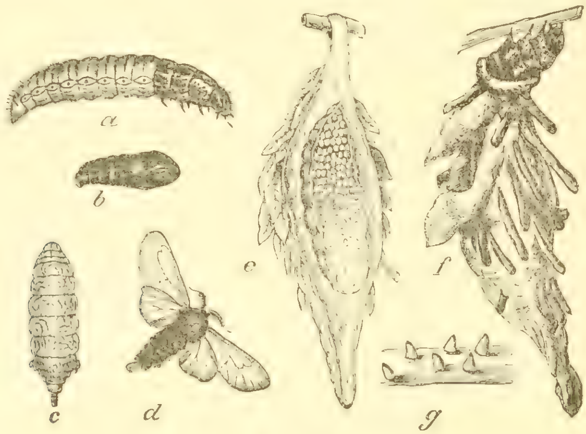

FIG. 37.

of encouragement will occur to you, but, as already stated, with comparatively few exceptions, such as those indicated, the multiplication of our parasitic and predaceous species on the line of the first method is practically beyond our control.

It is quite different in the second method of dealing with beneficial insects, for here man has an opportunity of doing some very effective work, and it is only within comparatively recent years that the importance of this particular phase of the subject has been fully realized. The Rev. C. J. S. Bethune, of Canada, was probably the first entomologist to suggest, in one of the earlier volumes of the *Canadian Farmer*, the importation of the European parasites of the Wheat Midge (*Diplosis tritici*) into America, on the supposition that this cosmopolitan species might thus be kept in check on this continent to the same extent that it was in Europe. So far ar I am aware, the attempt was never actually made, and though some subsequent correspondence was entered into between Fitch and Curtis, and later between Walsh and some of his English friends, nothing tangible resulted. The matter was, in fact, never seriously studied with this purpose in view.

The importance of this phase of the subject was early forced upon my attention, as it was upon that of others, and is frequently referred to in my earlier writings. Thus, in 1869-70, in studying the parasites of the Plum Curculio, it became evident that they were of such a nature that they could easily be trasported from one locality to another, and I distributed from Kirkwood, Mo., *Sigalphus curculionis* Fitch and *Porizon conotracheli*, Riley, to several correspondents in other parts of the State. I also urged a similar course with regard to some of the parasites of the Coccidæ, which it happens may be easily transported from one place to another in their undeveloped or adolescent stages.* Le Baron, in his studies of the Oyster-shell Bark-Louse of the Apple and one of its parasites (*Aphelinus mytilaspidis*) transported scale-covered twigs during winter from Geneva, Ill.,

* Third Rep., Ins. Mo., 1870, p. 29; Fifth Rep., do., 1873, p. 90.

to Galena, Ill., with beneficial results. The experiment was conducted on a small scale, but the parasites issued and became domiciled in their new locality, thus proving the practicability of his scheme. In neither of my experiments nor in Le Baron's, however, was sufficiently thorough examination made to prove that the parasites did not already exist in the localities in which they were colonized.

Planchon and myself introduced *Tyroglyphus phylloxeræ* from America into France in 1873,† and it became fully established, as subsequent correspondence and observation showed. In 1874 efforts were made to send over from England to New Zealand certain Aphid parasites to check the alarming increase of those plant pests there, and while I have no records at hand to show with what success, the later successful introduction of bumblebees to the latter country to fertilize the red clover is well-known history. In his report upon the parasites of Coccidæ in the Annual Report of the Department of Agriculture for 1880, Mr. Howard gave the subject some theoretical attention and elaborated upon the ease with which Coccid parasites could be transported from one part of the country to another during winter. He suggested the experiment of transporting *Dilophogaster californica* from the Pacific coast to certain of the Southeastern States, where it might be expected to prey upon certain large species of Lecanium. In 1883, after previous futile attempts by myself and Mr. Otto Lugger, and with the assistance of G. C. Bignell, Esq., of Plymouth, England, the living cocoons of *Microgaster glomeratus*, a common European parasite of *Pieris rapæ*, were successfully imported by the Department and the colonization of the species was established, not only in the District of Columbia, but in Iowa, Nebraska and Missouri, as specimens were simultaneously sent to the agents of the Division in those States. ‡ It has become so widely distributed since then as to lead to the inference that it must have been previously introduced at some other points, though the spread of an introduced species, even when introduced at a single point, is often so rapid that it surprises us, especially of a species that is winged, as evidenced by the spread of the Horn Fly (*Hæmatobia serrata*) over the whole eastern United States in about four years. Later, in 1891, with the aid of Mr. Fred. Enock, of London, a successful effort was made to introduce into this country from England an imporant Chalcid parasite of the Hessian Fly, *Entedon epigonus*, Walker, (*Semiotellus nigripes*, Lind.). The details of this experiment will be found in my published writings, especially in my report as U. S. Entomologist for 1891, and it is only necessary to state at this time that parasitized puparia of the Hessian Fly were received in large numbers and distributed to various points, and placed in the care of competent observers in Illinois, Indiana, Michigan and Canada. The results so far have not been marked, and but one positive report as to the acclimation of the parasite has been received, viz, from Prof. S. A. Forbes, of Champaign, Ill. I am of the opinion, however, that the lack of evidence from other points is due almost entirely to lack of proper examination, and I have every hope that the species will before long be found to have obtained a secure foothold at all of the several points of introduction. It is a very difficult matter to ascertain the existence of a parasite of this minute size, except when it occurs in great numbers. It requires an eye trained not only to the examination of these minute creatures, but one familiar with the allied imported species and native species. The reason for attempting the introduction of this particular species was simply that in England it was found to be far more abundant and far more beneficial than any of our native species have so far proved.

The present year I have become interested in the matter of the importation of a predaceous Noctuid (*Erastria scitula*) which preys upon the Black Scale (*Lecanium oleæ*) in south Europe and helps materially to keep it in check. With the help of Prof. H. Rouzaud, of Montpellier, France, who has studied the habits of this insect with extreme care, I hope to establish it in southern California, where the climatic conditions are sufficiently close to those of south Europe, and where the Black Scale does great damage to olive orchards, and to oleander trees, and also affects less seriously the Orange and Lemon. The Black Scale has already an important enemy in California in the shape of the Dilophogaster above mentioned, but the latter is only two brooded, and the scale insect, multiplying more rapidly, outstrips it in the race for maturity. The Erastria, on the

† Sixth Report, Ins. Mo., 1874, p. 55.
‡ Report of the Entomologist in Rep. U. S. Dep. Agric. for 1884, p. 323.

contrary, passes through five or six generations in the course of a summer, and, as it is purely predaceous, it will, I believe, prove a most useful auxiliary against the Black Scale, especially if brought over without its parasites.

So far I have spoken only of the insects which have been imported into this country, but some effort has also been made in the opposite direction. Thus we have endeavored (and with some success) to return the service done us by sending to Australia and New Zealand some of our predatory Coleoptera, some of the Pacific coast parasites of the Codling Moth, and a species of the interesting genus Raphidia, which also preys upon the Codling Moth.

In 1887 and 1888 the now well-known importation of *Vedalia cardinalis* from Australia and New Zealand to California, to prey upon *Icerya purchasi*, was successfully carried out. The history of this striking example of the beneficial results that may, in exceptional cases, flow from intelligent effort in this direction, is now sufficiently well known to American economic entomologists ; but anticipating that we shall have foreign delegates among us, and that our proceedings will be published more widely than usual, it will, perhaps, be wise to give the salient historical facts in the case, even at the risk of some repetition of what has been already published. In doing this the indulgence of the society is craved for the prominence of my own part in the work, rendered necessary by the disposition in some quarters to distort the facts.

The Fluted Scale, otherwise known as the White or Cottony-cushion Scale (*Icerya purchasi*, Maskell) Fig. 38, is one of the largest species of its family (Coccidæ), and up to 1888 had done immense injury to the orange groves and to many other trees and shrubs of Southern California. From Australia, its original home, it had been imported into New Zealand, South Africa and California, the evidence pointing to its introduction into California about 1868, and, probably, upon *Acacia latifolia*.


FIG. 38.

In my annual report as U. S. Entomologist for 1886, will be found a full characterization of the species in all its stages ; but the three characteristics which most concern the practical man, and which make it one of the most difficult species to contend with, are its ability to survive for long periods without food, to thrive upon a great variety of plants, and to move about throughout most of its life.

The injuries of this insect, notwithstanding the efforts to check it, kept on increasing, and some ten years ago I felt that the work of this particular species and of others which seriously affected the fruit-growing interests of Southern California, justified the establishment of agencies there. Up to this time no special entomological effort had been made by the Government on behalf of the fruit-growers of the Pacific coast. Through agents stationed, the one at Los Angeles, the other at Alameda, a course of elaborate experiments was undertaken as to the best means of treating the insects affecting the Orange there, and more particularly this Fluted or Cottony-cushion Scale. During the progress of these investigations, however, the fact impressed itself upon my mind that we had here an excellent opportunity of calling to our aid its own natural enemies, for while there were some doubts as to the origin of Icerya, the question was finally settled to my own satisfaction that it was of Australian origin, and that in its native home it was not a serious pest, but was kept subdued by natural checks. These facts were not positively ascertained without a good deal of correspondence and investigation, involving, in fact, a trip to France, as has been set forth in my published writings upon the subject.

In my report as U. S. Entomologist for 1886, in an address before the State Board of Horticulture at Riverside, California, in 1887 ; in a paper before the Philosophical Society of Washington in the winter of 1888, and elsewhere, I urged, with all the force at my command, the advisability of endeavoring to introduce the natural enemies which

were known to keep it in check in Australia. Certain indigenous species had been discovered preying upon it in California, and I expressed the belief that, as they increased, the fruit-growers would get more and more relief from the Icerya ; but I also urged that there was much more chance of success from those which keep it in check in its native home, and which were not imported with it to the countries of its introduction. The case was exceptional, and the attempt thus urged gave every promise of a rich reward. Efforts were made to introduce some of these natural enemies through correspondence, especially with the late F. S. Crawford, of Adelaide, with what ultimate results the subsequent success of Vedalia forever rendered uncertain.

The Hon. H. H. Markham, present governor of California, was at that time a Representative in Congress, and through him chiefly, but also through others, I urged upon Congress the desirability of sending some one to Australia to make a thorough study of the subject with a view of introducing those natural enemies. Again, in the winter of 1887-'88 appeals were made to Congress, not only of a personal nature, but through memorials from various societies in California, for an appropriation to send one or two men to Australia to collect and increase these natural enemies. Congress, however, failed to make any specific appropriation, and also failed to remove the restriction in the appropriation to the Division of Entomology which limited travelling expenses to the United States and prevented independent action of the Department of Agriculture. It happened, however, that about this time an appropriation was made and a commission created to represent the United States at the Melbourne Exposition, and, with the appreciative aid and sympathy of the Hon. Norman J. Colman, Commissioner of Agriculture, I took active steps to gain the co-operation of the Secretary of State in my pet scheme, and by an arrangement with the Department of State, accepted by the commissioner to said Exposition, Hon. Frank McCoppin, the Department of Agriculture was finally enabled to send to Australia two agents of the Division of Entomology, one of them to be under my instructions, and the expenses of both, within the sum of $2,000, to be paid out of the appropriation for the aforesaid Exposition.

It was thus that Mr. Albert Koebele, in the fall of 1888, was sent to Australia for this special purpose. The history of Mr. Koebele's efforts has been detailed from time to time in Government publications and in the press, especially that of California. It suffices to state that a number of living enemies, both parasitic and predaceous, were successfully imported, but that one of them, *Vedalia cardinalis*, proved so effective as to throw the others entirely into the shade and render their services really unnecessary. It has, so far, not been known to prey upon any other insect, and it breeds with surprising rapidity, occupying less than thirty days from the laying of the eggs until the adults again appear. These facts account for its exceptionally rapid work, for in point of fact, within a year and a half of its first introduction, it had practically cleared off the Fluted Scale throughout the infested region. The expressions of two well-known people may be quoted here to illustrate the general verdict. Prof. W. A. Henry, director of the Wisconsin Agriculture Experiment Station, who visited California in 1889, reported that the work of Vedalia was "the finest illustration possible of the value of the Department to give the people aid in time of distress. And the distress was very great indeed." Mr. William F. Channing, of Pasadena, son of the eminent Unitarian divine, wrote two years later :

> We owe to the Agricultural Department the rescue of our orange culture by the importation of the Australian ladybird, *Vedalia cardinalis.*
>
> The white scales were incrusting our orange trees with a hideous leprosy. They spread with wonderful rapidity and would have made citrus growth on the whole North American continent impossible within a few years. It took the Vedalia, where introduced, only a few weeks absolutely to clean out the white scale. The deliverance was more like a miracle than anything I have ever seen. In the spring of 1889 I had abandoned my young Washington navel orange trees as irrecoverable. Those same trees bore from two to three boxes of oranges apiece at the end of the season (or winter and spring of 1890). The consequence of the deliverance is that many hundreds of thousands of orange trees (navels almost exclusively) have been set out in southern California this last spring.

In other words, the victory over the scale was complete and will practically remain so. The history of the introduction of this pest, its spread for upwards of twenty years, and the discouragement which resulted, the numerous experiments which were made to overcome the insect, and its final reduction to unimportant numbers by means of an

apparently insignificant little beetle imported for the purpose from Australia will always remain one of the most interesting stories in the records of practical entomology.

The Vedalia has since been successfully colonized at the Cape of Good Hope and in Egypt, and has produced the same results in each case. In Egypt the Vedalia was introduced to prey upon an allied species of Icerya (*I. ægyptiacum*, Douglas). We hope soon to be able to send the same insect to India, where it has recently transpired that *Icerya ægyptiacum* occurs, while recent information received from Phra Suriya, royal commissioner of Siam at Chicago, would indicate that its introduction into Siam for the same or a closely allied insect will be desirable in the near future.

In fact, the success of the experiment was so striking and so important, and resulted in the saving to California of an industry of so great a money value, that it has given rise, not only in the popular mind but in the minds of a certain class of entomologists also, to the idea that remedial work against injurious insects should be concentrated upon this one line of action, and that our best hope for their destruction lies with the parasitic and predaceous species, not to mention fungus and bacterial diseases. From an extreme of comparative incredulity the farmer and fruit-grower have gone, perhaps, to the other extreme of too great faith. The case of Icerya and Vedalia, as I have frequently pointed out, was exceptional and one which can not easily be repeated.

One of the humorous phases of the Vedalia experiment is, that the wide newspaper circulation of the facts—not always most accurately set forth—has brought me communications from all parts of the world asking for supplies of the renowned little Ladybird for use against injurious insects of every kind and description, the inquiries being made, of course, under a misapprehension of the facts.

While this California experience thus affords one of the most striking illustrations of what may be accomplished under exceptional circumstances by the second method of utilizing beneficial insects, we can hardly expect to succeed in accomplishing much good in this direction without a full knowledge of all the ascertainable facts in the case and a due appreciation of the profounder laws of nature, and particularly of the interrelations of organisms. Year in and year out, with the conditions of life unchanged by man's actions, the relations between the plant-feeder and the predaceous and parasitic species of its own class remain substantially the same, whatever the fluctuations between them for any given year. This is a necessary result in the economy of nature; for the ascendency of one or the other of the opposing forces involves a corresponding fluctuation on the decreasing side, and there is a necessary relation between the plant-feeder and its enemies which, normally, must be to the slight advantage of the former and only exceptionally to the great advantage of the latter.

This law is recognized by all close students of nature, and has often been illustrated and insisted upon by entomologists in particular, as the most graphic exemplifications of it occur in insect life, in which fecundity is such that the balance is regained with marvellous rapidity, even after approximate annihilation of any particular species. But it is doubtful whether another equally logical deduction from the prevalence of this law has been sufficiently recognized by us, and this is, that our artificial insecticide methods have little or no effect upon the multiplication of an injurious species, except for the particular occasion which calls them forth, and that occasions often arise when it were wiser to refrain from the use of such insecticides and to leave the field to the parasitic and predaceous forms.

It is generally when a particular injurious insect has reached the zenith of its increase and has accomplished its greatest harm that the farmer is led to bestir himself to suppress it, and yet it is equally true that it is just at this time that nature is about to relieve him in striking the balance by checks which are violent and effective in proportion to the exceptional increase of and consequent exceptional injury done by the injurious species. Now the insecticide method of routing this last, under such circumstances, too often involves, also, the destruction of the parasitic and predaceous species, and does more harm than good. This is particularly true of those of our Coccidæ and Aphididæ and those of our Lepidopterous larvæ which have numerous natural enemies of their own class; and it not only emphasizes the importance of preventive measures, which we are all agreed to urge for other cogent reasons, and which do not to the same extent destroy the parasites,

but it affords another explanation of the reason why the fight with insecticides must be kept up year after year, and has little cumulative value.

But the problem of the wise encouragement and employment of the natural enemies of injurious insects in their own class is yet more complicated. The general laws governing the interaction of organisms are such that we can only in very exceptional cases derive benefit by interference with them. The indigenous enemies of an indigenous phytophagous species will, *cæteris paribus*, be better qualified to keep it in check than some newly introduced competitor from a foreign country, and the peculiar circumstances must decide in each case the advisability of the introduction. The multiplication of the foreigner will too often involve the decrease of some indigene. If a certain phytophage is generally disastrous in one section and innocuous in another by virtue of some particular enemy it will be safe to transfer and encourage such enemy, and this is particularly true when the phytophage is a foreigner and has been brought over without the enemy, which subdues it in its native home. Icerya had some enemies in California, presumably American, but they were not equal to the task of subduing it. Vedalia, in the Icerya's native home, Australia, was equal to the task and maintained the same superiority over all others when brought to America. The genus was new to the country and the species had exceptionally advantageous attributes. But there is very little to be hoped from the miscellaneous introduction of predaceous or parasitic insects for the suppression of a phytophage which they do not suppress in their native home or in the country from which they are brought.

The results of the introduction by Mr. A. D. Hopkins of *Clerus formicarius* to contend with the Scolytids which were ruining the West Virginia pines were doubtful, for the reason that indigenous species of the genus were already at work in America. Yet the experiment was safe and desirable, because the European Clerus is more active and more seemingly effective than our indigenes. The Gypsy Moth was evidently introduced into Massachusetts without its European natural enemies, and as in some parts of Europe it is often locally checked by such natural enemies, a great number of which are known, a proper study of them and the introduction of the most effective could result in no possible harm and might be productive of lasting good. Such a course was advised by me at a conference upon the subject held in the rooms of the State Board of Agriculture, Boston, March 4, 1891,* and in correspondence with the Secretary of the Board. In neither of these cases should we expect the predaceous or parasitic forms to subdue their hosts more effectually in America than they do in Europe, except in so far as they were relieved, in the introduction into America, of whatever enemies they possessed in their native home.

There are two other laws which it is worth while to consider in this connection. One is, that while a plant-feeder's natural enemies are apt to cause its excessive abundance to be followed by a corresponding decrease, yet this alternation of excessive abundance and excessive scarcity will often be produced irrespective of such natural checks. An injurious insect which has been on the destructive march for a period of years will often come to a sudden halt, and a period of relative, and sometimes complete, immunity from injury will follow. This may result from climatic conditions, but more often it is a consequence of disease, debility, and want of proper nutrition, which are necessary corrollaries of undue multiplication. Frequently, therefore, it may be inaccurate and misleading to attribute the disappearance of a particular injurious species to some parasitic or predaceous species which has been let loose upon it, and nothing but the most accurate observation will determine the truth in such cases. The past year furnished a very graphic illustration in point. Throughout Virginia and West Virginia, where the spruce pines have for some years suffered so severely from the destructive work of *Dendroctonus frontalis*, not a single living specimen of the beetle has been found during the present year. This has been observed by every one who has investigated the subject, and particularly by several correspondents who have written to me; by Mr. E. A. Schwarz, who was commissioned to investigate the facts, and by Mr. Hopkins, who has made the study of the subject a specialty.

*INSECT LIFE, III., p. 369, ff.

The clearest explanation of this sudden change is that the species was practically killed out by the exceptionally severe cold of last winter, since such was the case with several other insects. Now, following so closely on the introduction by Mr. Hopkins of *Clerus formicarius*, how easy it would have been to attribute the sudden decrease to the work of the introduced Clerus, had not the decrease been so general and extensive as absolutely to preclude any such possibility. In like manner a certain scale insect (*Aspidiotus tenebricosus*) had become exceedingly destructive to the soft maples in the city of Washington last year, whereas the present year it is almost entirely killed off, evidently by the same exceptional cold. Many of the affected trees were painted with whitewash, with a view of destroying the Aspidiotus, and the death of this last might have been attributed to the treatment (and naturally would be by those employing it) were it not that the same result was equally noticeable on the trees not treated. Reports from southern California would indicate that the Red Scale (*Aspidiotus aurantii*) is, in many orchards, losing its destructiveness through agencies other than its insect enemies, and in this case the facts are particularly interesting because of the ease with which its disappearance may be attributed to some of the recent introductions from Australia.

The other law that is worth considering in this connection is that experience has shown that, as a rule, the animals and plants of what is known as the Old World—*i.e.*, of Europe and Asia—when introduced into North America have shown a greater power of multiplication than the indigenous species, and in a large number of instances have taken the place of the native forms, which have not been able to compete with them in the struggle for existence. The converse proposition holds equally true, viz , that our species when taken to Europe, do not hold their own against the European indigenes. This is still more true of the species introduced from the Old World, as well as from America, into Australia, where the advantage of the introduced forms, as compared with the indigenous, has been in many cases still more marked. All other things being equal, therefore, we should expect the species which are beneficial in Australia to be less so when brought to this country, a deduction which brings out still more clearly the exceptional nature of the case of Vedalia and Icerya, just as there are some notable exceptions, as in the case of the Grape Phylloxera, in the introductions between Europe and America.

There are some instances in which there can be no doubt whatever as to the good which would flow from the introduction of beneficial species, and an illustration is afforded in the Capri-fig insect, *Blastophaga psenes*. There can be no question as to the good which would result from the introduction of this species from Smyrna into those sections of California where the Smyrna fig is grown without its intervention, and there are other similar instances which promise well and involve no risk. But I have said enough to show that the successful utilization of beneficial insects is by no means a simple matter and that discriminating knowledge is required to insure success, especially in the second category dealt with in this paper. Wherever the importance of the matter leads to legislation what are denominated "political" methods are apt either to control or in some way influence the resulting efforts—too often with unfortunate consequences. We should, as economic entomologists, be on the alert for special cases where the introduction or dissemination of beneficial species promises good results, and do our best to encourage an intelligent public appreciation of such special cases, while discouraging all that is of a sensational nature, as likely to mislead and ultimately do our profession more harm than good.

THE ECONOMIC VALUE OF PARASITES AND PREDACEOUS INSECTS.

By John B. Smith, Sc.D., New Brunswick, N.J.

At the very outset I wish to disclaim all intention either of producing a treatise on parasitism in general or disputing the importance of parasites in nature. No one can realize more than I do how much parasites maintain the balance and check the increase of injurious species. I am perfectly aware that were it not for parasites many an insect would become so abundant that certain crops could not be satisfactorily grown. Fully realizing, therefore, the place and importance of these parasites, I feel at the same time

that their economic value has been grossly over-estimated: in fact I am almost ready to say that parasites have no real economic value to the agriculturist. This sounds like a very radical statement, and perhaps I do not mean it in the fullest sense of the terms that I have used, but I would not much modify the sense of the language. The "life history" of an insect is incomplete until we know not only how it lives and upon what it feeds, how it transforms, and the duration of its various stages, but also what species prey upon it, and to which it furnishes sustenance in one or the other of its stages. We are therefore right in our studies of the "life history" of injurious insects in studying also the parasites that prey upon them. We are right also in publishing the results of our work, including the descriptions of the parasites. We are right in calling the attention of the farmer to the fact that the injurious species are very largely kept in check by either parasites or by predaceous insects; but we are wrong in leading him to suppose that either parasites or predaceous insects will control the injurious species for him. Yet the tendency of the language used in many cases by entomologists, and more often by those who are not entomologists, has suggested the possibility that injurious species may be controlled by either parasites or natural enemies without very much work on the part of the farmer. The impression is current that it will be possible to use natural means to exterminate injurious insects, and I have been asked frequently during the past two years, by farmers who may be considered as fully equal in intelligence to the best in the land, those who read and usually understand, why I did not make some effort to cultivate or import parasites or natural enemies of our common injurious insects. Of course these questions all grow out of the remarkably successful experiment made by Dr. Riley in the importation of the Australian *Vedalia cardinalis* to exterminate the imported *Icerya purchasi*, and I have decided to bring up this subject for discussion at the present meeting in order that possibly a little more definite light can be obtained upon the exact place of parasites and predaceous insects in economic entomology. It needs no argument on my part to prove that nature never creates organisms merely to destroy others that she had previously created. Parasites do not exterminate their hosts in any instance; their mission is merely to interpose a check to undue increase, and it is natural that this should be so, for were the host destroyed the parasite itself would perish, unless it were able to change its food and prey upon other species. It is by no means improbable that in the past certain species have been exterminated by their parasites, and, indeed, it is very probable that some such cases are in progress now. Many lepidopterous larvæ are rarely found free from parasites, and the adults are among the rarest of our species. Here we have instances where the parasite very materially lessens the number of the host and allows each year only a very few specimens to escape. It is only through the fecundity of the species that it is enabled to maintain itself at all. These cases are exceptional. Usually the relation of the parasite to its host is more moderate. Excessive increase is checked, but excessive increase only. There is always a very large proportion of larvæ and usually a comparatively small proportion of parasites. Nature tends to preserve a balance among her creatures, and a balance only. Many species which are much subject to parasites are abundant each year, and remain equally abundant from year to year, varying only very slightly, and these variations are rarely the result of an excessive increase of parasites. Nature also works very slowly, and she adapts insects as well as other animals to their environment only by means that require ages for their completion. Insects that are confined to plants which, under natural conditions are not common, need few parasites to keep them in check. The great difficulty in finding food is in itself a sufficient cheek, and parasites are not necessary, indeed they could not be supported under the circumstances. If, by any unnatural condition introduced by man, the supply of food for this otherwise rare insect is suddenly increased, it obtains the possibility of multiplying rapidly, while the number of parasites do not increase proportionally. In the course of time nature may make a change and other species may attack this form which has now increased abnormally; but this is something that the farmer can not wait for; he must have some means of dealing with the insect at once, and he must leave the operations of nature to benefit his descendants. The spread and increase of the potato beetle, *Doryphora 10-lineata*, is a case in point. Here neither parasites nor natural enemies assist the farmer in any noticeable way. He must depend upon his

own exertions to save his crop. There are however, many insects which are very commonly parasitized, and among them may be mentioned the various species of cutworms. It is nothing uncommon to find in an infested field that fully one-half, and sometimes as many as three-quarters, of the specimens will have eggs of the Tachina flies attached to the skin, and probably others have parasites which are not externally visible. Yet the fact that these cutworms are infested by parasites is of absolutely no value to the farmer. They eat just as much as if they were not parasitized, and it is really a matter of little importance to the agriculturist whether the food that is stolen from him makes a moth or a fly. The caterpillar feeds all the same until it is full grown. Next year in the same field there will just as many cutworms as there were in the previous year. The parasites have kept the number within the same limit, and the farmer has not been benefitted. If he desires to save his crop he must himself adopt measures for the destruction of these insects; parasites will not help him in the least. Let us take another instance: One of the species of Tortricids infesting the Cranberries is very subject to the attacks of parasites, two species being abundant and a third rare; yet every year the bogs suffer equally from this species. If we collect a large lot of larvæ in the early spring, we will find that very few of them will give out parasites. From the second brood we will breed a great many more, while of the third and last brood, probably seventy-five per cent. will prove to be infested by parasites. This sounds very pretty, indeed, and we say that the insect has been controlled by its parasites, and so it has; but not until it has ravaged the bogs, and has done all the injury that it could do. It has destroyed the crop, and seeing the enormous increase of the parasites during the year, the natural conclusion is, that they will next spring still further reduce the number of their host and bring matters to such a state that little or no further injury is to be apprehended. Yet, as a matter of fact, nothing of the kind occurs. We find that somehow during the winter the mortality among the parasites has been very much greater than it has been among the moths, and that just as in the previous year the first brood of moths will be almost exempt from the attacks of the parasites. We will have on the bogs exactly the same history that we found in the previous year. Of what practical benefit is this parasite to the farmer? It does not do anything in the world to prevent the destruction of his crop, nor does it any way lessen the damage, for where these insects occur and are allowed to increase without check, except by their natural enemies, they appear in sufficient numbers each year to take the entire crop. This is not a solitary instance. It can be matched with ease in all our common insects. The Codling Moth, for instance, has parasites, and is doubtless kept in some check by them; yet every one present knows that if parasites and natural enemies alone were depended upon, farmers could not count on a single perfect apple. They do check the excessive increase of the insect, but they do not lessen in the least the number that can be supported by the food plants. All the parasites that have been described from the Codling Moth, from the Plum Curculio, and any others of our injurious insects do not benefit the farmer one dollar in the value of his crops, and I think it is well that this should be generally understood, because of the tendency that I have already mentioned to expect too much from the parasites It must be remembered also that in the operation of preserving the proper balance between life of all descriptions, nature itself has intervened to prevent the undue increase of the parasites, either by making them less fertile than the hosts upon which they prey, by giving them a smaller number of broods, or by supplying them in turn with parasites which keep them in check. This secondary parasitism is well known and it is as effective in preventing the excessive increase of the primary parasites as these are in preventing the excessive increase of the original host. There is really almost as much danger, and that is very little, that the secondary parasites will destroy the primary parasite as that the primaries will exterminate their host. Predaceous insects are in much the same case, they never entirely destroy the species they feed upon, and in 99 cases out of 100 they conquer their prey after all the injury has been done to the growing crops. Let us take the case of the Melon Louse for example. This makes its appearance in June or July, and increases with marvellous rapidity. Very soon after various species of Coccinellids make their appearance and begin preying upon the plant louse; but in the number in which they first appear they are incapable of eating up the lice as fast as they multiply. By Sep-

tember they are up with their prey, but then it is too late ; the crop has been destroyed, and although it is quite probable that the late broods have entirely rid the vines of plant lice, yet it has not benefitted the farmer one solitary cent. I had a beautiful opportunity of observing this in 1892. It was a pleasure to see how the late broods moved from vine to vine, leaving scarcely a living louse behind them ; but that same vine was dried and withered ; whatever fruit there remained on it was undersized, blackened by honey-dew, half ripe, and never in fit condition for market. Acre after acre I have seen in just that condition, and practically no revenue has been derived from the land. It is quite true that the beetles exterminated or nearly exterminated the plant lice, but this did not advantage the farmer one solitary cent. A few buckets of kerosene emulsion liberally applied early in the season, while the plant lice were running away from the lady-birds, would have been of a great deal more money benefit than all the aid that nature gave. My contention is, that in dealing with injurious insects from the farmer's standpoint, we can entirely ignore the work of parasites or predaceous insects. We must accept the fact that each year these insects will appear in about the same numbers ; that nature has evidently assumed that this is about the proper number to appear, and that all her checks are arranged accordingly. If we wish to lessen them, we must do it by means other than those which she has provided.

There is, of course, a possibility that we may in some cases make use of either parasites or predaceous insects. That has been very well illustrated by the instance before referred to, that of the Vedalia and the Icerya. The one point that is overlooked by the majority of those who see only newspaper accounts is, that we had to deal in the first place with an insect which was not a native, but which was imported. In the second place the insect preying upon it was also imported, and found as the only familiar form upon which it has been used to feed just this one species. In bringing over the Vedalia, its natural checks were not brought with it, and in liberating it in the orange groves of California, it was given an advantage that it could never have possessed in its own country. There may be a few of our insects in a somewhat similar position, and possibly some one of us may yet be as successful as Dr. Riley was in reference to some other permanently injurious species. It may even be that parasites which in their native home are not able to control or exterminate the species upon which they prey, may when introduced into this country, have such an advantage that they will accomplish more than they could in their native home. I say this may be so, but I do not anticipate it in many cases. Insects are very slow to change their habits. Just as it is rare for an American parasite to attack an imported insect in any numbers, just so rarely will we be able to induce a European or other foreign parasite to attack the American insects. We have a field here which is comparatively new, and of which we know very little, but it is not that particular field that it is my intention to enter. The propositions that I do make, and that I am ready to defend are : Among our native insects parasites act merely as a check to excessive increase. Excessive increase means more than the natural food of the insect is able to support, and does not mean excessive increase in the sense of the farmer. An insect that is, under natural conditions, abundant each year, must be dealt with without any regard to parasites or natural enemies. Other than I have just suggested, parasites and predaceous insects have absolutely no economic value.

INSECT FOES OF AMERICAN CEREAL GRAINS, WITH MEASURES FOR THEIR PREVENTION OR DESTRUCTION.

BY F. M. WEBSTER, WOOSTER, OHIO.

The three principal cereal grains of America north of Mexico, viz., maize, wheat and oats, cover an approximate area of from 140,000,000 to 150,000,000 acres. In other words, the natural flora over this vast territory, comprising a great variety of species, has been largely exterminated, and, instead, but three have been substituted, all of which are annuals with a capacity for reproducing each year from twenty to two thousand fold. As nature is said to abhor a vacuum, so does she resent a monopoly, except it be in cases where but few species can exist, and the increase of the individuals of these are ultimately restricted by other influences, such as a rigorous climate or a barren soil. Our grain fields include neither the barren desert, the frozen mountain tops nor the ice-clad regions of the far north, but the fertile prairies and valleys over which vegetation naturally grows in great luxuriance and profusion, each species, if left to itself, being kept in its proper numerical sphere by natural laws. The agriculturist, however, comes upon the scene and incites an insurrection, causing the three species before mentioned to not only rebel, but overrun and take possession of these broad acres, putting the original inhabitants to death and establishing themselves in nearly or quite full power. If the contest were wholly a natural one, the interlopers would soon be forced into their proper places, and exist only in proportion as they could resist the returning encroachments of the natural flora. But the plow and the hoe again interpose, and the victors still hold the field. Nature then does what is naught but good generalship, brings up her reserves in the animal and vegetable enemies of the three usurping species and precipitates them upon the foe. It is here that the hand of the husbandman seems to lose its cunning. He can fight the forests, the weeds and the grasses, but when it comes to warring upon the insects and fungoid enemies of his grains he seems to lose heart. His reserve force is, or at least should be, in his superior knowledge ; but too often this virtue seems to be either sadly aborted or entirely wanting. He does not study ways to destroy or circumvent these enemies of his crops, but, on the whole, allows them to go their way, patiently taking what they leave and hoping for better luck another year.

It is here that I wish to take up my subject and show how many of the insect foes may be either destroyed or prevented from inflicting serious injury. The field of applied entomology is not the science of killing insects, alone, but includes also the warding off of their attacks. For my own part I would reverse these terms, as it seems to me that the evasion of an attack is ordinarily the most important. I would put it in this way: Warding off the attacks of injurious species by preventing their breeding, and, in case this is not practical, destroying them either before or after the attack had begun. And I may be allowed to here make use of an oft-quoted adage, "An ounce of prevention is better than a pound of cure."

There are upwards of 140 species of insects affecting these three grain crops, and maize alone has over 100 insect foes, a number of course depredating alike upon all three. Of these, such as infest the stored grain excepted, there are very few whose attacks can not be far more easily warded off than remedied after they have begun. I know of no better insecticide than good farming, After eight years of study of the Hessian-fly (*Cecidomyia destructor*) I am satisfied that four-fifths of its injuries may be prevented by a better system of agriculture. For years I have seen wheat grown on one side of a division fence without the loss of a bushel by attack of this pest, while on the other side the crop was almost invariably more or less injured. No effect of climate, meteorological conditions, or natural enemies could have brought about such a contrast of results. The whole secret was in the management of the soil and the seeding. In fact, the question of success in evading the pest, in the one case, did not appear to be an entomological one at all ; and I am fully convinced that the Hessian-fly problem, so far as it relates to agriculture, throughout that portion of the country lying between the Alleghany Mountains and the Mississippi River, and between the Ohio River and the Great Lakes, may be considered practically solved.

Heretofore we have told people that the fly could not exist except where fall wheat was grown. But this can be said no longer, as the pest occurs in North Dakota and in a locality where fall wheat is never sown. As the fall brood of flies emerges continually earlier as we go northward, it seems to me that we must eventually reach a point where it will cease to appear in autumn at all, and go over until spring, a state of affairs that will easily account for the breeding in spring wheat in North Dakota. In other words, I expect to find that nature has protected the species alike from the protracted northern winter, and the equally prolonged southern summer, by varying its resting season with the latitude, and, possibly, also with its proximity to the seacoast. That is, we shall find the insect passing both the hot and cold seasons largely in the flaxseed stage, that being the stage of development during which it is best protected from the elements and the lack of food.

There are several good reasons why we might expect the fall brood to become extinct to the north, while the spring brood continues, the principal one being that there is not sufficient time for the former to develop before the cold season begins. Besides, in the continuity of the species it can best be spared, and I understand that it is not present in England. In nearly all cases where a species is two-brooded, the spring-appearing brood of adults is the producing while the fall is the diffusing brood. The spring-appearing flies are loth to leave the field in which they originated, and prefer to oviposit on the tillers of the wheat plant, while the autumn-appearing adults will spread out everywhere over the country, and will, seemingly, scent out a field of wheat at long distances. They can even be drawn to very small plots in the midst of large cities. With the Aphides the winged female produces fewer young, but spreads them over a larger area. In *Isosoma tritici* the spring brood of females has so far followed this rule in the past that their wings are either entirely absent or aborted, while the summer brood, *grande*, has invariably fully developed wings and is the diffusing brood. The Army Worm, *Leucania unipuncta*, is destructive through one brood only, the fall brood being far less gregarious. This is also true of the Chinch Bug, *Blissus leucopterus*, though in Northern Indiana and Northern Ohio I find the larger parts of the adults with aborted wings. The spring brood of Hessian Fly, coming as it does from plants that will continue through a sufficient season for their progeny to develop, has no need to migrate, while those that summer in the stubble must necessarily change, as the plants can furnish no further nourishment ; besides, diffusion and differentiation serve in a measure, to protect from natural enemies. But, notwithstanding this, it will be easily observed that the latter brood can be best dispensed with without material and permanent injury to the species. This appears to me to be the state of affairs that we may look for. I do not wish to be understood as making the unqualified statement that these conditions do exist, and only hope that members of this association, located to the north and to the south of the area indicated, will be able to prove either the truth or fallacy of my position. We have much yet to learn in regard to this Hessian fly, and a study of it in any locality would probably develop some new features, or at least new parasites.

There are some facts connected with the two species of Isosoma, *I. tritici* and *I. hordei*, that, to me at least, are rather puzzling. Unless an undermined species, found in New York by Dr. Lintner, proves to be *tritici*, I am not aware of its occurring east of the Alleghany Mountains, though it reaches west to the Pacific coast. On the other hand I never saw *hordei* in Illinois or Indiana, nor did I find them in central Ohio, yet I had not been a week in the northern part of the latter State before I found them in abundance. They occur, generally, over the north portion of the State and into Michigan. Is it not possible that *hordei* is of northern origin, where the season is too short for two broods, while *tritici* has pushed up from the south, where the protracted vernal season is favorable for the development of two broods? I find that the *hordei* almost invariably selects small wheat plants in which to oviposit, while the summer brood of *tritici* as invariably selects large, thrifty stalks, usually where the plants are thin on the ground but rank growing. In northern Ohio I never find *hordei* far below the upper joint, an exceptional feature I believe, though it seems to me we might look for such a state of affairs, as it oviposits during a season intervening between the spring and summer broods

of *tritici*. Then, too, I notice the parasites of *hordei*, at least *Eupelmus allynii*, French, *Semiotellus chalcidiphagus*, Walsh, and *Websterellus tritici*, Ashmead, emerge in August and oviposit in the same straws from which they themselves emerged, the adults from these emerging in spring. I have also noted the same thing in the two former species where their host was the Hessian Fly. In both cases, however, I got fewer parasites in spring than in August.

So far as measures for their control are concerned, *tritici* can be largely overcome by a rotation of crop, while both this and *hordei* will be destroyed by burning the stubble, a measure equally applicable to the Hessian Fly and Wheat Stem-maggot, *Meromyza americana*. In some portions of the country, however, clover is sown among the young wheat in early spring, and a burning over in summer under such conditions is impracticable.

I wish to call attention to a few points in reference to the Chinch Bug, *Blissus leucopterus*. The area of extreme continued injury by this pest covers southern Minnesota, southeast South Dakota, much of Nebraska and Kansas, all of Iowa, and much of Missouri, Illinois, all of Indiana except northeastern portion, extreme southwest Ohio, and northern Kentucky, though in the wheat region of the Mississippi Valley the pest is by no means limited to this area, nor does it confine itself to the wheat region at all.

They are more abundant in Louisiana, where wheat is never cultivated, than they are in northern Ohio, where this cereal is one-half of the grain crop. When they were working their greatest havoc in southern and central Illinois and southwest Indiana I looked in vain for them in northern Indiana. I do not understand why it is that a very large per cent. of the adults found in Ohio, along Lake Erie, and in northern Indiana possess only aborted wings; yet I have found this to be the case. As you all know, the insect parasites of this species are very few and of little account in holding it in check. For aid in this direction we must look to the meteorological conditions unfavorable to their increase and fungoid and bacterial parasites. These last will be found available during some seasons and within a certain limit, but nature is not likely to use one of her servants to annihilate another. We may be able to emphasize their work in this direction by continual artificial cultivation and distribution; further than this we can not expect to go, and the relief will at best be but local and temporary, though not by any means without value in limited areas. The only difficulty is that we, with certainty, can not foretell a year of destructive abundance, and a few false alarms will so discourage the ordinary farmer that he will do nothing to protect himself. For my own part I feel quite sure that if the bugs can be induced to oviposit in spring in small plots of Millet or Hungarian grass, they can be controlled by the use of these vegetal diseases to far better purpose than to attempt to do so in the fields of ordinary cultivation. But there must be, somewhere, a central source of supply where requests for material can be promptly filled, as has been done by Prof. Snow, before the plan will prove a success. Next in value to such plats is, I think, the cornfields where the young bugs must of necessity congregate in compact masses and thus facilitate contagion.

It would appear almost visionary to advocate spraying apple orchards in midwinter to protect the wheat crop, but nevertheless one of the most serious enemies of young fall wheat passes its egg stage on the twigs of the Apple during the winter season. I refer to the Apple Leaf-louse, *Aphis mali*, Fab. Soon after the young wheat plants appear in the fall the winged viviparous females of this species flock to the fields and on these give birth to their young, which at once make their way to the roots, where they continue reproduction, sapping the life from the young plants. On very fertile soils this extraction of the sap from the roots has no very serious effect, but where the soil is not rich, and especially if the weather is dry, this constant drain of vitality soon begins to tell on the plants. Though they are seldom killed outright, these infested plants cease to grow, and later take on a sickly look, and not until the Aphis abandons them, in autumn to return to the Apple, do they show any amount of vigor. It is very seldom that the affected plants fully recover, at least in autumn, and the result must be to reduce their productiveness the following year.

The greater number of serious pests of our fields of Indian corn are such as work to their injury below the surface of the ground. The larvæ of Elaters devastate our lowlands and the grubs of Lachnosterna ravage the higher lands, while Cutworms, Web-

Worms, and Corn-Root-worms are found generally diffused over both. The Corn-Root-worm, *Diabrotica longicornis*, excepted, all of these seem more destructive to a crop of grain following a grass crop or pasture. Yet this is not always true. I have known of fields of corn being seriously affected by white grubs when such fields had not been devoted to grass for a single season in twenty years.

In the case of Wire Worms some good results may be secured by fall plowing, though as the adults emerge in August or September, and winter over also in this stage, we can hope to do little with these. There are, however, during the winter two young generations in the soil, and against these a fall plowing may and evidently does have an ill effect What a summer fallow would do I have had no opportunity of learning. There are no end of reported successes and failures among farmers, but there is so much obscurity shrouding these that one cannot judge of their authenticity. Once and once only, have I felt quite sure of having beaten these pests. This was in the case of a field of grass land, plowed in spring and planted with potatoes. The worms nearly ruined the crop, and in the fall the ground was still well populated with them. The following spring potatoes that had escaped notice when the crop was harvested seemed to attract the worms, and the latter were found burrowing in the tubers in great numbers. On my suggestion, hogs were turned into the field, and these rooted out and promptly disposed of both potatoes and worms, no injury occurring to the following crop, which was of corn. There may be some virtue in the application of kainit, although this has not as yet been thoroughly and clearly demonstrated, and, besides, over the vast corn belt of the North-west, its application is impracticable. For myself, I am willing to confess ignorance of any unfailing, practical measure, either of prevention or destruction. Fall plowing and a rapid rotation of crops are as yet the best measures we can recommend.

White Grubs, the larvæ of several of our species of Lachnosterna, appear to give preference to the higher lands. Where the soil of such lands is of such a nature as to wash easily during winter and spring, fall plowing results in the washing out of great gullies, thus constituting a grave objection to the measure. Outbreaks of this pest seem to be usually of triennial occurrence, different localities being affected during different years, and I have thought we might accomplish something by mapping out these areas, and so warn the agriculturist of their probable appearance. Here, however, the same trouble awaits us. A single mistaken prediction discourages the few who will follow our direction, and we get only derision from the remainder. In my own correspondence I have advocated the same measures against these as in case of the Wire Worms, viz., a rapid rotation of crops, especially of grass or clover, and fall plowing, whenever it can be done without detriment to the fields What has, or is likely to be accomplished by the use of fungoid parasites, I do not know. The opinion of our presiding officer, who is experimenting in that direction, will be of interest to us all. As in the case of the Corn Root louse, *Aphis maidis*, Fitch, or *Aphis maidi-radicis* Forbes, less injury is done in fields that have been fertilized with barnyard manure.

The Corn Root-worm, *Diobrotica longicornis*, Say, has by its ravages cost the farmers of the Mississippi Valley millions of dollars during the last fifteen years, every penny of which might have been saved by a judicious system of husbandry. Every member of this association, located in the infested area, has again and again sounded the alarm and announced the remedy, yet I fear there are some who have not heard it. In Ohio it is unknown, except along the western border of the State. Its occurrence here, where it was reported last year for the first time, raises the question of its eastward diffusion—a problem which I hope to be able to solve. The congener of this species, the Southern Corn Root-worm, *Diabrotica 12-punctata*, Oliv., will certainly not be managed so easily. There is yet some investigation to be done on this species, before we can confidently advise in regard to its destruction. It appears, in the adult stage, to be well nigh omnivorous, and the larvæ travel freely.

The Corn or Boll Worm, *Heliothis armiger*, Hbn., is more especially a Southern species, though as far north as Chicago, there are during some seasons two broods, as, in that portion of Illinois, I have found half-grown larvæ in the ears of ripe corn, in November. In the North the damage done is trivial, often being due to the rain and dew running into the affected ears, causing them to decay. Among the market gardeners, where

it works in the sweet corn, the measure suggested by Prof. French, several years ago, which was late plowing in the fall, will do much to hold the species in check. In the South the most sensible and practical suggestion that I have seen mentioned is to plant corn early among the cotton in order to attract the early brood of worms, and then destroy the corn in a way to kill the depredators.

For the major portion of the cutworms, I have much faith in laying down of poisoned grass or clover baits, but the larvæ of *Hadena devastatrix*, Brace, and H. *stipata*, Morris, can not be reached in this manner, as they do not come to the surface to feed. The first eats the plants directly off a short distance above the roots, while the last eats into the stem at about the same place, then tunnels its way upward, eating out the heart after the manner of the Stalk Borer, *Hydrœcia nitela*, Gn.

I have here to introduce a third species of Hadena, *H. fractilinea*, Grt., and an entirely new depredator in our cornfields, at least so far as published records are concerned. In fact we rarely find the species mentioned at all in our entomological literature. The imago was described in the *Canadian Entomologist* (vol. VI, p. 15, January, 1874), the habitat there being given as Canada (Petit), Albany, N. Y., (Lintner). Prof. G. H. French, who first determined the species for me, has it from Maine and New York, and Prof. John B. Smith has it from Maine to Ohio, Minnesota to Colorado. How far south it extends I do not know. The adults are so exceedingly quick in movement and secluded in habit that it is not surprising that it should be overlooked. Several specimens of both sexes that were transferred from the cage in which they were reared to another in which grass was growing were not observed afterwards.

The habits of the larvæ are in strange contrast with those of *stipata*, at least in the cornfields, where that species works entirely below ground, entering the stem just above the roots and eating its way upward, while in this species they climb up the plant and eat downward, devouring the whole interior of the stem down to a point where the *stipata* would begin. If the plant be a young one—that is only 2 or 3 inches in height—these larvæ will enter the cylinder formed by the youngest leaf ; but if the plant be older and tougher they will eat downward along the edges until the tissue is more tender, when they will enter the stem and work downward. The time of oviposition I am unable to give. Larvæ, from two-thirds to quite full grown, were taken the last of June, when they were said by farmers to be disappearing. From these larvæ imagoes appeared, *in the insectary*, the last days of July and up to the 10th of August. I did not observe them, nor can I learn of their occurrence elsewhere than on spring-plowed grass land, and this, either wholly or in part, timothy sward. There appeared to be no difference in point of injury between early and late spring plowing. There did not appear to be any disposition on the part of the larvæ to wander about, but if the corn was planted in hills, after finishing one stalk they would abandon it and attack another, and so on until all were destroyed.

The larvæ, from which all of my adults were reared, were taken from corn plants, either in the field or from plants sent me by my correspondents, and I saw every one of them in transferring them to the breeding cages. All were working in corn in precisely the same manner and there was certainly no noticeable difference in the larvæ. The imagoes, however, were those of two species, as they are now understood, the larger number being the one under consideration, while the remainder were *Hadena misera*, Grt. If, therefore, the two species are distinct, then this almost must be added to the list of corn-destroying insects, and a further study will be necessary to separate the larvæ, whose depredations appear not to differ. Prof. Smith writes me that he has this last species from Colorado, taken by Bruce, and also from Minnesota, bred by Prof. Lugger. All this, of course, does not disprove the validity of the species, as, if I remember rightly, there is a strong resemblance between the larvæ of *H. fractilinea* and *H. stipata*, as I observed them in corn in Indiana some years ago.

The various species of web worms, larvæ of several species of Crambus, are, of late, working nearly as much damage in our cornfields as are the cutworms, and are even less accessible. The larvæ of at least three species have this season devastated the cornfields of eastern Ohio, one of which appears to feed below ground exclusively. For my part, I

am puzzled to know how to deal with these. Can it be done by breaking the sod in early summer, and allowing the wind and sun to dry out and kill the grass roots, thus starving the very young worms? The plan of breaking the ground very late in spring and planting the crop immediately I find often fails of protection.

In conclusion, permit me to direct attention to the fact that the field of the economic entomologist is but poorly defined. To work out the life history of a species and study its relations to other forms of life, learn what substances will destroy it, determine what course of procedure is calculated to prevent its breeding, would appear to constitute our true field of labor, but we are expected, by some sort of magical power, to transform ourselves into carpenters, mechanics, or civil engineers, and devise machines, methods, and all the details of application in a manner to fit the current notions of agriculturists.

Now, it seems to me that this is not necessarily all applied entomology. It belongs, it appears to me, equally as much to the science of applied agriculture, and I am in favor of giving the farmer the opportunity of putting his own shoulder to the wheel and exercising some of his own ingenuity to help himself. Outbreaks of the injurious insects, like the diseases of the human system, are due to certain foregoing causes over which the entomologist has no control whatever, but when the trouble comes we are expected to go out and instantly stop it. You all know how impossible this is, and yet how difficult it is to make people understand the impossibility of it. I think that at present we are doing our whole duty and even more.

I congratulate the members of this association on the progress we are making. No nation on earth is making or ever has made such rapid advances. We make some mistakes it is true; who that does anything at all does not? Honest errors are not only no disgrace but may be of value to those who follow after. We are profiting by the mistakes of Harris, Fitch and Walsh; why may not those who shall carry the work forward after we are gone likewise profit by ours?

In discussion, Mr. Howard stated that *Isosoma tritici* occurs outside the limits Mr. Webster assigned it, since it has been found east of the Alleghanies.

Mr. Forbes remarked that it cannot be inferred that the Hessian Fly is single brooded in a region where no winter grain is raised, on the evidence of the absence of winter grain alone, since volunteer spring grain may give opportunity for the breeding of a second generation, and in this connection instanced an observation of his own in the spring wheat region of northern Illinois, where the fly is admittedly double brooded, but where he found it infesting barley in spring.

In reply to questions Mr. Webster stated that a difference in the relative injury by Hessian Fly observed by him in two fields was due to the better condition in which the ground was kept in the case of one of them, so that wheat sown late enough to escape the fall attack grew rapidly and went into the winter in prime condition, while in the other field the wheat, if early sown, was infested, and, if sown late, was winter killed.

Mr. Webster stated in this connection that the fall brood of the fly scatters everywhere for oviposition, while the spring brood does not range widely, but is most likely to lay again on other plants (suckers, etc.) in the same field.

Mr. Riley asked Mr. Webster to give some account of the actual experiments and observations which had led him to make the statement in reference to the Apple Aphis (*Aphis mali*). He had for a number of years known that this species had a summer existence on various grasses, and had been very anxious to have Mr. Webster, while an agent of the Division of Entomology, follow the full annual cycle of development so far as the wheat plant was concerned.

Mr. Webster said that he felt that his experiments were sufficiently conclusive.

The fourth session was held on the morning of August 16. The Committee on the President's Address reported in favor of the adoption of his recommendations, and the appointment of a standing committee to present a detailed plan for co-operative work among members and to make recommendations concerning legislation. The report was adopted and Messrs. Osborn, Smith and Garman were appointed a committee.

FUMIGATION WITH BISULPHIDE OF CARBON FOR THE COMPLETE AND RAPID DESTRUCTION OF THE INSECTS WHICH ATTACK HERBARIUM SPECIMENS, FURS, WOOLLENS, ETC.

By H. du Buysson, Brout Vernet, France.

The fumigating chest for use with bisulphide of carbon has been employed for many years in the preservation of unpoisoned herbaria, which would infallibly be devoured without this annual or biennial precaution. These fumigations may render great service in the preservation of other objects more useful than the specimens of a herbarium. I shall describe, therefore, the first method used, and every one will know how to apply it to his own needs.

Description of Fumigating Chest.

It is in principle a rectangular box of light wood, lined with thin zinc, which is carefully soldered at all joints. Around the edge of the box, inside, runs a little gutter of zinc, carefully soldered. This gutter is filled with water and serves to make a water seal by means of the flange of the lid, which is also covered with zinc and carries all around a strip of the metal bent at right angles, and long enough to plunge into the water in the gutter. In this way the box is hermetically sealed and the vapors of the bisulphide cannot possibly escape from it.

Use in the Preservation of Herbaria.

Botanists now generally poison their specimens, and the fumigating box is seldom used. Nevertheless it has served me well and I still resort to it from time to time, to preserve such plants as I have not time to submit to the action of arsenic in alcohol or to bichloride of mercury.

The process in question is based upon the great volatility of bisulphide of carbon at ordinary pressure and moderate temperature. The penetration of its vapor is so considerable that we have only to pile up in the chest the mounting sheets of the herbarium, one above the other, in order to fumigate them. They are penetrated to the very centre, and eggs, larvæ, and perfect insects, Anobium or Attagenus, are killed. Space should be left and right of the pile for the vessels containing the bisulphide. Those which I use are of zinc and measure 10cm. long, 6cm. wide, and 9cm. deep. There is no risk in prolonging the fumigation; on the contrary there is but the greater certainty of its being efficacious. Five or six days will be time enough. No limit need be set to the quantity of bisulphide used; what is not evaporated will serve for a new charge.

The disagreeable odour of bisulphide of carbon is not persistent; it is not even necessary to spread open the mounting sheets; it is only necessary to expose them, unopened, to the air. I would call attention, however, to one very necessary precaution, if accidents are to be avoided. The vapor of bisulphide is very inflammable, and the chest must, therefore, be set in a safe place and not opened near a fire or any flame whatever. It would be risky, for example, to unpack the chest in the evening while holding a lamp in the hand.

As the odor of bisulphide is very disagreeable and may cause discomfort to some persons, all these operations should be performed in an attic or in an apartment of which the windows may be left open as long as necessary.

Preservation of Furs and Woollens.

The same process may be used in the preservation of clothing in clothing establishments, civil or military, where Tinea and Attagenus sometimes cause such ravages. Special arrangements may be adopted in establishing fumigating chests or rooms to avoid the settling due to weight and to facilitate the penetration of the gas.

This method makes it certain that we shall not "shut the wolf up in the sheepfold." Articles fumigated are entirely rid of eggs, larvæ, and living insects. They may be shaken out in the open air for greater security and then replaced on the shelves, with the assurance that they will not be found gnawed when next visited.

Preservation of the Stuffing of Furniture and Saddles.

Tinea and Attagenus have a marked predilection for horsehair, so that these insects are sometimes found flourishing in the stuffing of our furniture, even that which is in daily use. This process has the advantage of permitting us to destroy them without having recourse to the upholsterer; we need but to construct a fumigating chest large enough to contain a couple of armchairs or more. In the same way we may treat mattresses, eider-down quilts, or anything which is supposed to contain eggs or larvæ.

I have experimented with a saddle much damaged by months, and after fumigating it five days noticed no appearance of insects; the saddle was completely penetrated by the vapor and all the moths perished. I kept it two years under observation in order to be assured of the efficacy of the process.

Disinfection in Epidemics.

I am persuaded that clothing subjected to this process would be disinfected quite as well as by the processes usually employed in certain epidemics, such as typhus, cholera, smallpox, etc. It seems to me that the vapors which penetrate fabrics so well and kill insects so thoroughly would act in the same way upon the microbes which engender epidemics.*

In discussing this paper Mr. Atkinson stated that he had used a very similar box in fumigating objects infested with insects.

Mr. Garman called attention to the fact that at the museum of comparative zoology at Cambridge, a large upright zinc lined case was constantly used for disinfecting the skins of birds and mammals.

Mr. Riley had used bisulphide of carbon successfully for his insect collections.

Mr. Smith had used it successfully for ants, and found it not injurious to vegetation.

Mr. Garman reported having found it effective in destroying the Melon Louse. His method of applying it was to roll the vines up in a heap, then invert a tub over them, and after placing a saucer containing a tablespoonful of the bisulphide under the tub, its edges were pressed down into the soil or the earth was drawn up when necessary. He had tried the fumes of burning sulphur and tobacco, but the former injured the plants and the latter did not kill the plant lice, many of them gradually recovering after being stupefied by it.

Mr. Smith thought since the aphides often spread from particular plants or hills, the use of bisulphide in good season might make it possible to prevent the injuries of these insects.

Mr. Atkinson read a paper by Dr. J. Ritsema, Bos., on "Aphelenchus olesistus, nov. sp., a nematoid Worm, causing Leaf-sickness on Begonia and Asplenium." He referred to a note by Mr. Atkinson read at the preceding meeting of the Association, in which an Anguillulid is described as affecting leaves of Chrysanthemum and Coleus, making no swelling or deformity, but causing brown patches on the leaves. The author having studied and described *Aphelenchus olesistus* in Europe, where it causes almost precisely the same trouble with Begonia and Asplenium, is inclined to think that the species previously mentioned by Mr. Atkinson is identical. In the discussion Mr. Atkinson stated that while there were characters in the form studied by him which seemed to place it in the genus Tylenchus, he thought that careful comparison of types might show the two to be identical.

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*Note.—I have observed in bisulphide of carbon no clearly defined power of taking out the colors of fabrics which I have subjected to its vapor. It may, therefore, be used without fear, except, perhaps, in the case of the most delicate tints.

METHODS OF ATTACKING PARASITES OF DOMESTIC ANIMALS.

By Herbert Osborn, Ames, Iowa.

In dealing with insect parasites of domestic animals we need to consider, first, the method of attack of these parasites, and we may conveniently separate them into the external parasites and the internal parasites. Among the former we have various species of lice, itch-mites, ticks, and can also include those forms which affect the external parts of the body by depositing eggs in sores. In the latter series we may include the different kinds of bot flies affecting the internal organs and certain forms of degraded Acarina which also affect certain internal organs. It is unnecessary here to detail the mode of attack of the external forms more than to mention that some pierce the skin to suck the blood, others simply feed upon external excretions, producing pustules, scabs, etc.

First among the methods of treatment we should consider that of prevention, since, for perhaps the majority of the parasitic forms, a little effort in the direction of prevention is far more effective than costly and laborious methods later on.

With a large majority of parasitic species, including all of the lice, the sheep-infesting Hippoboscidæ and all of the Sarcoptidæ, infection results from the mingling of parasitized animals with those which are free from parasites. It is therefore possible by attention to animals introduced into a herd, or sometimes into a new section of country, to prevent entirely the introduction of the parasites. To accomplish this it is necessary to examine introduced animals, and if infested, or suspected of being infested, use thorough treatment upon these. In the case of introduced cattle infested with Hypoderma it would seem possible that they might, by being carefully watched and the grubs destroyed, be prevented from introducing this pest in any new locality. Since the parasite occurs only in the bodies of cattle during the winter season, I see no reason why attention to imported cattle should not serve to totally exclude this pest from any locality which has hitherto been free from it. The bots in horses may be prevented by the well-known method of shaving off the eggs, so as to prevent the introduction of the larvæ into the mouths, while for the bot fly affecting the sheep I am not aware of any more effective plan of prevention than that of applying tar to the noses of the sheep. For direct treatment, the methods for external parasites may be grouped under the head of washes, powders, and fumigation. The use of washes, in the treatment of parasites is perhaps one of the oldest methods. The modifications consist in the methods of applying or in the materials used as a wash. The method of application will depend somewhat upon circumstances, but should aim to reach all parts of the body, and particularly those parts most infested. Sponging the animal with a cloth or sponge dipped in the insecticide material and application by means of force pump in certain cases, particularly for hogs and thin-haired animals, is practicable in certain forms. A device recently presented by Dr. Francis, of Texas, provides for the pressure by means of gravity, the barrel being elevated on a derrick and connected by hose with several nozzles directed downward, and a movable one to use in spraying the under parts of the body, the liquid being collected by a drip platform in a receptacle below. The liquid, however, is elevated by a pump, and while it may lessen the number of men necessary in spraying, the same end can easily be accomplished where a force pump is at hand, if it is connected with several nozzles adjusted so as to play at proper angles on the animal. Dipping is probably the most speedy and effective method to use on a large scale, and especially for thick-haired or woolly animals, and for this purpose receptacles ranging all the way from a small tank for the treatment of a single animal at a time up to a large tank, including two or three dozen sheep at once, may be used. The ingredients for these washes have consisted mainly of tobacco, sulphur, lime, tar, kerosene, and arsenic, and each of these materials will be found to have its advocates.

Special formulæ for their combinations have been published in abundance, and need not be repeated here. Aside from these published formulæ there are different preparations on the market, some of which are doubtless valuable, and if the item of expense is considered satisfactory, it is perhaps proper to recommend their use. Kerosene emulsion

has been used with success by Prof. Gillette on cattle and hogs and by Dr. Orcutt and Mr. Alkrich for sheep dip, but Prof. Francis pronounces it less satisfactory than some of the proprietary combinations for ticks on cattle. I have also seen some reports of poor success with it or apparent injury, especially to lambs, from its use.

While I fully believe in its efficiency when properly made and applied and would attribute failures to improper preparation, the fact that such failures occur in practice is somewhat unfavorable to the general adoption of this remedy.

The various powders used are tobacco, sulphur, pyrethrum, snuff, and common road dust (the latter presumedly acting by closure of the spiracles) and of the other substances, tobacco or preparations including this material may probably be considered as most generally useful.

Pyrethrum if dusted in among the hairs so as to thoroughly reach the insects when first applied, is quite effective and may be used for fleas and lice, but probably would not affects the mites.

Fumigation is a method which presents some advantages where it is practicable, because it can be used during winter when washes are objectionable and is preferable to powders, because all of the individuals affecting an animal may be killed and thus entirely free it, whereas by the other method the survival of a few individuals may restock the animal. A simple plan of adopting this is to cover the animal with a blanket, leaving the eyes and nose exposed, but having the blanket reach the floor or ground and made as tight as possible at all points to prevent the escape of fumes. Puff tobacco smoke under this blanket by means of a bee-smoker. This plan first came to my notice as recommended by Mr. Charles Aldrich, who claims for it very effective work. I have also seen a description of a plan for fumigation of fowls which involves the same principles. Some years ago I suggested the plan of using a tight stall, with an opening at the head, a canvas protection, so as to leave the head, eyes, and nose exposed and free; and some experiments with this method showed that fumes of either sulphur or tobacco are very effective in destroying lice, both the Pediculidæ and Mallophagidæ. The time of exposure to the fumes varied from twenty to twenty-five minutes in these experiments. The sulphur or tobacco were burned over an alcohol flame, but I should presume a preferable plan would be to place the substance in a tin or sheet-iron tube, closed at one end, with the open end projecting into the stall, and drive the fumes off by means of heat applied to the under surface. The common little lamp-stove could be used. The stall should be made as small as possible to accommodate the animal, in order that the fumes may be as dense as possible, and on this account the simple covering with a blanket is perhaps preferable, as it adjusts itself to the animal, but provision should be made for the free circulation of fumes on the parts of the animal where the blanket would press.

Feeding of sulphur with salt is strongly recommended by some, and Mr. Weed, of Mississippi Station, gives it a strong endorsement as a result of experiments at that station directed especially against the cattle tick (*Ixodes bovis*, Riley).

Mr. Gillette asked how the hen louse could be destroyed.

Mr. Osborn, in reply, said he thought the use of tar on the ends of the poles in the henhouse could be made to answer the purpose.

Mr. Aldrich thought it not safe to recommend kerosene for destroying insects on animals, because of the injurious effect on the skins of the host.

Mr. Gillette replied that he agreed that kerosene should not be used for sheep, but for hogs and cattle it was useful.

Mr. Riley remarked that he was deeply interested in a change of opinion resulting from later experience and experiments regarding the usefulness of the kerosene emulsion in destroying animal parasites, and particularly in Mr. Gillette's altered experience in reference to its use on sheep. He thought, however, that the difficulties of making a good kerosene emulsion and of getting intelligent farmers to use it safely were unnecessarily magnified. He could not accept the doctrine that of two given remedies the poorer one was to be recommended because the better required a little more care and intelligence in making and using.

Mr. Hopkins had used sulphur for stock at all times and found it not injurious.

Mr. Weed reported that sulphur and salt mixed were fed to stock in Mississippi for ticks. Some thought it ineffective. But it was tried at the station and found to be a complete remedy. It had been claimed that sulphur used during wet weather was injurious, but this was tried and found not to be true. Sulphur has been supposed to cause a decrease in the quantity of milk, but careful experiments at the Mississippi Station had shown this to be untrue. The sulphur and salt should be kept in use constantly. Ticks, he thought, infested by preference, animals in poor health, and the chief good done by feeding sulphur and salt was keeping up the health of stock by destroying internal parasites.

Mr. Gillette inquired if the real bedbug ever occured in hen houses. A case occurred in Iowa where bugs, which appeared to be the same as that found in dwellings, were abundant.

Mr. Howard remarked that Townsend, of New Mexico, had recently discovered another species (*Cimex inodora*, Dugès) in henhouses.

Mr. Osborn thought the character of the form occuring in henhouses might be considered either varietal or specific.

In the paper by Mr. Weed on "Remedies for Insects Injurious to Cotton," the author discussed the application of Paris green against the Cotton Worm by means of bags at the extremities of a long pole carried by a "darkey" on a mule going at a brisk trot between the rows. This he considered to be the most simple apparatus which he had seen for distributing dry poisons. For the Boll Worm he considered the best application to be the planting of a row of corn about every tenth row through the cotton field at such a time that it will mature early in September.

THE CHEESE OR MEAT SKIPPER.

(*Piophila casei.*)

By Mary E. Murtfeldt, Kirkwood, Mo.

In dealing with the insects detrimental to agriculture the entomologist encounters no obstruction in the reluctance of the farmer to have his losses made known. With the pessimism characteristic of the profession, the latter is inclined to exaggerate rather than to make light of his difficulties and losses. and therefore gives the fullest publicity to any agency from which he suffers ; but in the investigation of the habits and economic relations of an insect injurious to manufactured products the case is very different. The prudent manufacturer or merchant is very careful not to give to the public any fact which might arouse suspicion concerning the quality or durability of his products or wares. In the case of manufacturers such caution is especially necessary, as the tide of trade is so easily turned, and there are so many rivals in the field eager to take advantage of the smallest fact to the prejudice of a competitor. As an instance of this, one of our shoe manufacturers in St. Louis found, some years ago, that his stock was being injured by the Leather Beetle (*Dermestes vulpinus*, Fabr). In his desire for a remedy he very appropriately applied to Dr. Riley, of Washington, who instituted an investigation as to the nature of the depredator and the means for eliminating it. I had the honor to assist in these studies, and I well remember the change of manner in the proprietor of the concern between the first visits to his establishment and those made later. At first every facility for observation was granted, and all questions fully and obligingly answered ; but subsequent visits were somewhat coldly received and very little information could be elicited, and there was a general air of desiring to ignore the whole matter. This was explained some time afterward, when a partner in a rival firm chanced to mention that his business had profited considerably by the publication that So-and-So's shoes were "wormy ;" and the latter declared that the attention which the "bug-hunters" had drawn to the matter "had damaged his trade to the extent of several thousand dollars." Such experiences inculcate caution in mercantile circles, and through this the entomologist undoubtedly loses many an interesting subject for study. Perhaps this might be amended if it was understood that names would not be published without permission.

In the case of the insect upon which I beg here to offer a few notes, no household pest is, perhaps, better known. The manufacturer, the grocer, and the housekeeper, have each a considerable share in the loss which it occasions. For ages it has been the chief enemy of the chesse maker, the best and richest of his products being most liable to its attacks. It does not, however, confine its ravages to cheese, but within comparatively recent years has become known as an equally, or rather far more, formidable destroyer of cured meats, causing the loss of thousands of dollars' worth of property annually, and necessitating the spending of other thousands in labor and mechanical contrivances to keep it in check.

Although of European origin, it has spread to all parts of North America, where it probably does tenfold the damage that it does in its native country. In view of these facts, and considering the hundreds of articles that have been published upon insects of no greater economic importance, it is really surprising that the American records of this pest should be so few and so brief. Before entering upon an investigation of its habits I made a search for the literature of the subject, only to find that it had received but slight attention from our entomologists, from either a scientific or an economic standpoint The only notes relating to it that are to be found in the annals of American Economic Entomology are the following:

In the *American Entomologist* (vol. II.), published in 1870, is a copy of an article by X. A. Willard, giving a somewhat elaborate account of the destructiveness of the insect as a "cheese fly," with various recommendations of measures to be taken in factories and storerooms to preserve the products from its attacks. Appended to this is an editorial note giving an outline of its life history, with the statement, that so far as was then known, it was exclusively a cheese pest. In volume III. of the same periodical, published in 1880, Dr. Riley briefly discusses it as an enemy of cured meats, here asserting its identity with the cheese fly. Dr. Packard, in his Guide, gives in a few lines its principal characteristics, and refers to an observation of Prof. Putnam concerning the method by which it "skips." In volume IV. of *Pysche* I remember to have seen something on the subject, but can not at present lay my hands upon the number containing it. In the report of the Entomological Society of Ontario for 1884 is also a brief paragraph of description of it as a cheese pest. Not doubting that there were other works not in my library in which it was more fully discussed, I applied to Dr. Williston, as our leading dipterologist, who very kindly answered:

> I, also, have had occasion to search for the life history of *Piophila casei* without success. I supposed there would be no difficulty in finding a full description of its habits, but was surprised to find no, or very meagre, references in any literature at my command. . . . If you have studied its habits you will do a service by publishing them, even though it may happen that they have already been published, which I doubt.

Dr. Riley, however, informs me that the literature of the insect is sufficiently extensive, though scattered, and that several European writers, and especially H. F. Kessler have within recent years given careful accounts of its development and life history.

As it was my desire to bring the matter to the attention of the economic entomologists at the present meeting, I did not have time to obtain transcriptions from the authorities to which Dr. Riley refers, and so will offer here a popular synopsis of my personal observations, in which I am conscious there are some gaps and uncertainties. Those desiring a more minute and technical account can consult the works named by Dr. Riley.

My attention was directed to this pest about a year ago by an employee of one of the largest packing and curing establishments in the West, who wrote: "We wish to know what it is, and especially at what period in its life it can best be fought. It entails an enormous loss upon all our packing-house companies." Upon my request specimens of the infested meat were kindly sent me, and Mr. D——, my correspondent, gave me much valuable information concerning its work in the packing-house.

The packages of ham and shoulder were received during the month of August, 1892, and consequently represented the worst work of the insect for the season. Swarms of flies escaped from the boxes as they were opened, and myriads of "skippers" and puparia in all stages of development were disclosed, clustering around the bony ends, among the tendons, and in the softer fat and oil saturated folds of the canvas wrappers. The lean meat was never in any case penetrated, although eggs and small skippers were abund

on the surface ; nor was the solid fat much damaged. The methods of curing these meats had been so perfect, that even after an exposure of two or three weeks in an open shed to the August heats, upon cutting into the centre of a ham and the thickest part of shoulder they were found to be perfectly sound and sweet. In justice to the "skippers," too, I must say that their work does not induce putresence or ill odors, and although the spectacle of a ham swarming, externally, with the various forms of the insect is the reverse of appetizing, yet a large part of it is still edible, and, the outside removed, would be available for potted meats and similar preparations. But, of course, in the original shape it is absolutely unsaleable ; hence the loss.

The life history of the insect, so far as I have been able to trace it, is as follows, popularly presented : It hibernates in the perfect state, hiding, like the house fly, in cracks and crevices of the buildings which it frequents, and behind furniture and machinery. The flies become active only when warm weather sets in. According to my informant they are first noticed, in the curing establishments, around the vats of "yellow wash," which is composed of glue, rye flour, and coloring matter, possibly attracted by the odor of the glue. If not rigidly excluded they follow the pieces of canvassed and yellow-washed meat to the storerooms and deposit their eggs upon the wrappers, preferably among the folds, if they can find an opening that will admit them, otherwise upon spots where the fat has penetrated and loosened the wash. It has been difficult to ascertain the exact number of eggs laid by a single fly, as they are deposited not only in more or less compact clusters of from five to fifteen, but are also scattered singly. In the observation jars the average was about thirty, but it is possible that in these jars, confined upon small bits of meat and subject to much disturbance, the conditions were not normal, and the number of eggs may, in consequence, have been reduced. Those of an individual seemed to be all deposited about the same time, in the course of an hour or less, soon after which the insect perishes. The egg is pearly-white, slender oblong, slightly curved, 1^{mm} in length, with a diameter about one-fourth the length. Hatching takes place within thirty-six hours, and, leaving a filmy pellicle behind, the minute, translucent-white larva moves with wonderful activity in the direction of the food supply. Except in increase in size, it does not change much in its characteristics. It is cylindrical, tapering gradually toward the anterior end, and is truncate posteriorly, furnished at this extremity with two horny, projecting stigmata and a pair of fleshy filaments.

There is no variation in the white color except in the retracted mouth-hooks, which show a shade of dark gray. Dr. Packard, in his Guide, quotes from an observation of Prof. Putnam regarding the leaping power of the insect :

> When about to leap, the larva brings the under side of the abdomen toward the head while lying on its side, and reaching forward with its head and at the same time extending its mouth hooks, grapples by means of them with the hinder edge of the truncature, and pulling hard, suddenly withdraws them, jerking itself to a distance of four or five inches.

To my knowledge the distance to which it "skips" is often much greater. I think the "skipping" a latent power in the insect as a meat pest, as there is no occasion to exercise it by the majority of the individuals. When breeding in cheese it would be necessary in many cases to escape by this means to some place in which it could transform in safety, but on the canvased packages of ham and bacon the folds of the wrapper afford the most desirable of hiding places. It completes its growth in seven to eight days, attaining a length of from 7 to 9^{mm}, with a diameter at the posterior end of 1.5^{mm}. While feeding, if the food supply is sufficient, it does not move about much, entire clusters of larvæ often completing their growth in the same bony crevice in which the mother fly had deposited the eggs. When mature, however, it crawls, pulling itself along, apparently by the mouth hooks, into some fold of the wrapper that is comparatively dry, and from which the fly will easily be able to escape. Here it begins to contract in length and assume a yellowish hue, and the separation of the outer skin from the body can be clearly seen. The former gradually hardens and darkens into a golden brown, oblong segmented shell, 4 to 5^{mm} in length, and which still retains the larval projections on the posterior end. Within this puparium the larva rests for a time—I have reasons for believing for thirty-six or forty-eight hours, perhaps longer—unchanged, except for a slight reduction in size. I had occasion to observe the action of one of these larvæ whose case was accidentally broken. It wriggled and twisted about in the most unsatisfied manner, but seemed to

have lost its skipping power, and was constantly thrusting its head or its posterior extremity into the deserted puparia that were scattered at the bottom of the jar. Whether it was able to complete its transformations I can not now say.)

Both transformations, although involving such radical, formal and functional changes, take place within a period of ten days, as nearly as I have been able to ascertain.

The perfect insect is a shining black fly with bronzy tints on the thorax and slight iridescence of the wings. The latter overlap nearly to the tips when the insect is at rest. The legs are dull black, shaded at the joints to dull yellow or fuscous. In size it is about one-half that of the common house fly. There is no good figure of this insect in any American publication, that in Packard's Guide being in outline merely and not available for recognition except by the skilled entomologist. The fly is not active at night, but is able to perform its life work in the obscurity of partially darkened closets and storerooms. To make these absolutely dark would, in my judgment, effectually exclude it.

I have not been able to make it oviposit on fresh meat of any kind, nor does it seem able to breed upon that which is simply salted, but not smoked, not even when such meat is folded in wrapping papers. It will sip a little at sweets, but is not greatly attracted to them, while the odor of smoked meat speedily summons it. The average duration of life, in the perfect state, in summer, does not exceed a week, according to observations made upon it in the rearing jar, which may not, however, exactly indicate it. The entire life cycle would seem to be included within three weeks, but there is no definite succession of broods, and the insect may be found in all stages from May until October or November. When exposed to severe and protracted cold, larvæ, pupæ and flies are killed. The flies speedily succumb to the fumes of burning sulphur or pyrethrum powder, and the latter, if dusted upon them, produces the same stupefying effect that it does upon other Diptera. The firm in whose behalf these investigations were undertaken informs me that in order to exclude the fly they screened all windows and doors with a 24 to the inch wire mesh. They also, early in the spring, thoroughly whitewashed and fumigated smoke-houses and storerooms, using an admixture of carbolic acid in the whitewash, thus effectually sealing up or killing all hibernating individuals that might be lurking in these places. I have not been able to recommend any repellant chemical that could be safely incorporated with the wash used on the outside of the wrappers. Mr. D—— also informs me that sulphur fumes in the storerooms give a streaked and unattractive look to the wash, and the use of this repellant is therefore impracticable.

Smoked beef also suffers to some extent from the attacks of this insect, but, as Mr. D—— says, "not nearly so badly as pork. If a beef ham were hanging beside that of a hog, the former would most likely be O. K., while the latter would be stung."

In my correspondence with cheese manufacturers I learn that the loss of their products is now far less than it formerly was

One of our leading cream-cheese makers writes :

We are always somewhat troubled with the cheese flies in summer. To keep them out of our store rooms we cover the windows with light domestic, as they will go through the ordinary wire screen, but as there will always be more or less of them in the rooms, we have the brown fly paper in water always on hand, which keeps them pretty well in check. They are worst during the hot season. We do not use any chemicals, as they would be likely to injure the quality of the cheese. The flies deposit their eggs on the outside of the cheese, and in thirty to thirty-six hours they begin to squirm and work their way inside, so we usually go through the rooms twice a day and look for eggs. They are easily found on the smooth surface, but if the bandage is wrinkled or cracked we sometimes miss them. We have not had over $5 worth destroyed in two years, and are turning out 800 cheeses per day.

Another large manufacturer informs me that he

depends mainly upon fine screens to keep out the fly, and also darkens his storerooms ; has each cheese rubbed hard each morning ; uses no chemicals, but a cheese grease that contains some rosin, which gives a hard coating. Loss not more than 1 per cent., some seasons not over one-fourth of 1 per cent.

These reports are encouraging as showing with what comparative ease the insect may be kept in check when once its habits are thoroughly understood. It is hoped that these few notes, not in all particulars conclusive, may prove of some assistance in popularizing that knowledge.

Mr. Aldrich spoke of an English custom of placing cheese under the tap of a beer keg, so that the drip would encourage the development of the insect. He had been informed that the maggots improved the quality of the cheese.

Mr. Riley said it was true that this was not only an English, but a European practice.

Mr. Coquillett's paper, entitled, "Hydrocyanic Acid Gas as an Insecticide," was read by the Secretary. The paper consisted of an historical review of the use of this gas in California, together with an account of the methods in use at the present time and some slight consideration of its effect upon different insects. The cost of fumigating a tree varies from 5c. to $1, and even at the latter rate figures were produced to show that it is economical.

ON ARSENICAL SPRAYING OF FRUIT TREES WHILE IN BLOSSOM.

By J. A. Lintner, Albany, N. Y.

The long-mooted question: Are honey bees poisoned by arsenical spraying? is still an unsettled one. There are those who claim that a great mortality among bees is the result of their visiting blossoms that have been sprayed with Paris green, while others hold that the mortality so frequently observed at this time is ascribable to other causes, and that the arsenic would not reach the nectar of blossoms, and, being an insoluble substance, could not affect the bees or be communicated to the honey. This latter view has been entertained by some of our best botanists. The pollen, however, might contain arsenic and thus become poisonous, not only to the bees visiting the blossoms, but also to the nearly-matured, chyme-fed larvæ, to whom it might be conveyed.

In behalf of a committee appointed by the Association of Economic Entomologists to investigate the matter, Prof. F. M. Webster, of the Agricultural Experiment Station of Ohio, chairman of the committee, has recently reported progress in the investigations undertaken, to the following effect: He had experimented with a hive of bees placed underneath a sprayed plum tree wholly inclosed with a fine netting. Within two days thereafter a large number of dead bees were taken up from the cloth with which the ground had been covered. Without much doubt, most of these had been killed in their efforts to escape from their confinement. Examination of the bodies of the dead insects before washing and after they had been washed, to remove any arsenic that had been attached to their surface from contact with the sprayed blossoms, gave to the examining chemist the presence of arsenic. In another experiment made, hives of bees were placed under sprayed trees, but without any enclosing net These also gave dead bees with arsenic upon them, but in much smaller numbers.* The experiments were not deemed conclusive by Prof. Webster, and it is intended to continue them another year.

That the bodies of crushed bees that had visited blossoms sprayed with arsenic should disclose to chemical tests the presence of arsenic is not at all strange. Even an ammoniacal bath could not have removed every trace of arsenic from the surface of their bodies.

Prof. A. J. Cook, the distinguished apiarist of the Michigan State Agricultural College, makes the positive assertion that honey bees are killed in large numbers through the arsenical spraying of fruit trees in blossom, but he has not proven the assertion. Experiments instituted by him, in which bees fed on sweetened water poisoned by arsenic—1 pound to 200 gallons—were killed, are claimed by him as decisive upon the question under consideration. How entirely unwarranted the conclusion! The experiment had no bearing upon the question at issue. No one could have doubted that imbibing strongly poisoned syrup would be fatal to honey bees. Furthermore, in his experiment (see Report of the Michigan Board of Agriculture for 1891) the bees were fed in his laboratory, within a small cage. Bees are known to die very soon in confinement, even without an arsenical diet.

A simple method can be resorted to, by which the question could be definitely and effectually settled. It is this: Confine a hive of healthy bees to blossoms sprayed with Paris green, and when death speedily follows, have examination of their stomachs made

*It is possible that these bees may have been caught and killed by some of the predaceous insects, which are known to lie in wait among or near blossoms, whence they suddenly seize the bees and suck out their *juices*, such as the bee-slayer, *Phymata erosa*, and several of the "robber flies" or Asilidæ, of which Prof. A. J. Cook records six species having this habit.

by experts testing for arsenic. If it is found therein, then it may be accepted as the cause of their death. Examination of stomachs of bees collected promiscuously would not be satisfactory, for the statement was made at a recent bee-keepers' convention in Albany that honey bees had been seen eagerly feeding on the liquid resting on the leaves of a potato patch soon after it has been arsenically sprayed, and it was thought to have caused the death of many of the bees.

Up to the present, so far as I know, no examination such as above suggested has been made. I hope that Prof. Webster will undertake it in the progress of his experiments during the coming season.

Prof. Cook desires that "everyone of the United States should pass a law making it a misdemeanor to spray fruit trees while in blossom." I do not know that this, although urged in some of the States, has been done in any. Such a law was passed by the Ontario Legislature in April, 1890. It provides:

SEC. 1. No person in spraying or sprinkling fruit trees during the period within which such trees are in full bloom shall use, or cause to be used, any mixture containing Paris green or any other poisonous substance injurious to bees.

SEC. 2. Imposes a penalty, on conviction, of not less than $1 or more than $5, with or without costs of prosecution.

That the above law is calculated to protect the interests of both the fruit-grower and honey-producer is the opinion of Prof. J. H. Panton, of the Ontario Agricultural College, as given in Bulletin LXXXI, of the College, issued in November, 1892. He remarks:

Although there has been no analysis of the bodies of the dead bees for the purpose of ascertaining the presence of arsenic, still the death of the bees is so intimately associated with spraying that there seems but little reason to believe otherwise than that the bees have been poisoned by Paris green used in spraying. However, this will likely soon be settled by analysis of the bodies of bees suspected to have been poisoned, and I have no doubt arsenic will be detected.

There is another important question connected with the arsenical spraying of blossoms, viz, this: May not the arsenic blight the blossom and prevent fruit development? "The portion of pistil," says Prof. Panton, "upon which the pollen falls is exceedingly tender and sensitive, so much so that the application of such substances as Paris green injures it to so great an extent that the process of fertilization is affected and the development of fruit checked." No experiments known to me have been made upon the effect of arsenical spraying on fruit blossoms. That its effect would be to destroy the blossoms is quite probable. Thus, Mr. James Fletcher has suggested the spraying of the blossoms of pear trees infested with the Pear Midge (*Diplosis pyrivora*, Riley) as a remedy for annual attacks of the insect by depriving it of the food (within the young fruit) needed for its development.

There are, then, before the economic entomologist and the fruit-grower, at the present time, these two questions relating to spraying with the arsenites during the blossoming of fruit trees: First, will the poison kill the bees, destroy the young brood and affect the honey? Second, will it blight the blossoms? It would not be a difficult task for an experimental station, and it is specially within the province of the stations, to set these questions at rest and no longer leave them subject to crude observations or individual opinions. Until this shall be done, there should be an entire cessation from arsenical spraying of fruit trees while in blossom, without the enactment of laws which now seem premature and may prove to be not needed; and even if seeming to be needed, are still fraught with evil, from the general disregard with which such laws are treated.

It is unnecessary to say that there should be no restriction of the kind, either optional or compulsory, unless it is shown to be absolutely required. The arsenical spraying of fruit trees has already come to be regarded as almost indispensible to the successful fruit-grower, and day by day its importance is being more fully and widely realized. No longer limited to the control of Codling Moth injury, it is being rapidly extended to other insect attacks. For each week of early spring, I have no doubt but that a calendar could be made wherein each day would stand for the incipiency of the attack by some insect pest or fungous disease, to be combatted in no better way than by arsenical or copper solutions used in spraying. What opportunities may therefore be lost for arresting and defeating attack at the most favorable time, and possibly at its only vulnerable stage, if two or three weeks' armistice is accorded to your enemies, during

which time the army is recruited a hundredfold, the infant becomes a veteran, mines are run, pits are dug, tents are built, covered ways are constructed, insidious mycelium threads are permeating leaf and twig, and in many other of the arts of warfare your wily foes, with their rich inheritance of surprising means for self-protection, have planted themselves in strongholds, where an entire park of spraying pumps, with their baneful poisons, will utterly fail of reaching and destroying them. Far better a cessation of hostilities for any six weeks later in the season than for three in early spring. It has been stated and reiterated many times that the Codling Moth is the only insect against which we need to employ the arsenites in early spring, but this is far from the truth. It is conceded that we can not destroy the Apple Worm until after the fruit is set and the egg deposited thereon, but of the two hundred and eighty known species of insect depredators on the Apple (not referring to those infesting other fruits) it would be strange indeed if there were no others which are specially vulnerable before the setting of the fruit. Let me name a few of those that could be reached at this time :

The well-known Apple-tree Tent caterpillar of *Clisiocampa americana*, Harris, attacks the bursting buds and the young leaves.

The caterpillars of the White-marked Tussock-moth (*Orgyia leucostigma*, Sm.-Abb.) hatch from the eggs about the middle of May and commence their destructive work.

Among the cut-worms there are a number of climbing species, four of which have been identified, viz., *Agrotis clandestina*, Harris, *A. scandens*, Riley, *A. messoria*, Harris, and *A. saucia*, Hübn., which are known to ascend apple and other fruit trees to feed upon the blossom and leaf-buds and the tender leaves. The odd-looking caterpillar of *Catocala grynea*, Cramer, feeds on the foliage of the apple in May, and those of *Catocala ultronia* Hübner, are often shaken from plum trees when jarring them for the curculio.

The Canker Worm (*Anisopteryx vernata*, Peck) usually appears as the young leaves are pushing from the bud.

The White Eugonia (*Eugonia subsignaria*, Hübn.) one of the family of measuring worms, occasionally appears in injurious numbers about the 1st of May.

The oblique-banded Leaf-roller of *Cacœcia rosaceana*, Harris, spins together the young leaves for its shelter.

The Lesser Apple-leaf Folder (*Teras minuta*, Rob.) attacks the opening foliage and folds the leaf for its retreat.

The Leaf-crumpler (*Phycis indiginella*, Zeller) awakening from its winter's sleep and drawing some of the unfolding leaves together, resumes its feeding.

The destructive Eye-spotted Bud-moth (*Tmetocera ocellana*, Schiff.) so injurious in Western New York, after its larval hibernation in its half-grown state, makes its formidable attack, first on the buds and afterwards on the leaves.

The Apple Bud-worm (*Eccopsis malana*, Fernald) creeps at night from its retreat and, after having consumed the terminal buds, feeds upon the leaves.

The Apple-tree Case-bearer (*Coleophora malivorella*, Riley) emerges from its peculiar pistol-shaped case in which it has passed the winter, to eat the buds as soon as they begin to swell, and afterwards to skeletonize the leaves.

The Plum Curculio (*Conotrachelus nenuphar*, Herbst) enters upon the scene at least two weeks before its first crescent cuts are made in the fruit, ready and free to devote all its energies to obtaining the supply of food needed for the development of its eggs and for the labors attending its complicated and painstaking method of oviposition.

Seventeen species of insects are named above, each one of which is feeding voraciously during the blossoming of our fruit trees. Possibly as many more could be added to the list, all of which could best be destroyed by arsenical spraying.

It is therefore respectfully submitted whether there should be the intermission of spraying as proposed, urged and sought to be made compulsory through legislation, until it shall appear beyond all controversy that the interests of the agriculturist and the fruit-grower—each carefully considered and perhaps weighed one against the other—really demand it.

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In the discussion following, Mr. Webster stated that he had as yet reached no positive opinion as to the poisoning of bees by spraying.

Mr. Garman had observed in one instance a bee alight on a recently sprayed tree and suck up from a leaf a drop of the liquid containing London purple. He had no doubt that thirsty bees did sometimes get in this way some of the poison, but whether it was sufficient to injure them or not was a question requiring investigation.

The fifth session was held on the afternoon of the 16th August. The following officers for the ensuing year were elected:

President	L. O. Howard.
First Vice-President	J. B. Smith.
Second Vice-President	F. L. Harvey.
Secretary	C. P. Gillette.

Three papers on the insects of the season in their respective localities were read by Messrs. Webster, Smith and Osborn, and were discussed by Mr. Riley.

A paper by Mr. R. Allan Wight, of Auckland, New Zealand, was read by Mr. Osborn. It was entitled "*Icerya purchasi* and *Vedalia cardinalis* in New Zealand." The paper consisted of a condensed summary of the history of these two insects in New Zealand and their inter-relations. This paper was discussed by Mr. Riley.

Mr. Smith then read a paper by Mr. F. W. Urich, of Port of Spain, Trinidad, consisting of "Notes on Some Insect Pests of Trinidad, B. W. I." The paper was an interesting summary of Mr. Urich's observations on the injurious insects of that island, and referred mainly to Coccidæ and their natural enemies, a leaf-cutting ant (*Atta sexdens*) a longicorn beetle (*Steirastoma depressum*) and certain Acridiidae. Especial mention of a little Cyprinodont fish was made. This fish is found commonly all through Trinidad and feeds upon mosquito larvæ. Mr. Urich suggests its introduction into America for use in tanks and ponds.

The Secretary then read a "Note on Slip-records," by Mr. Cockerell. The author suggests the use of a uniform system of notes upon slips of a uniform size by all entomologists and submitted samples. The question was discussed by Messrs. Hopkins, Summers and Riley.

The Association then adjourned subject to the call of the Executive Committee.

BOOK NOTICES.

Experimental Farms: Reports for 1892. Printed by order of Parliament. Ottawa, 1893.

This valuable Blue-book has been before us for some time, having been distributed in April last, but various circumstances have prevented us from noticing it, and several of the publications for which we are indebted to the courtsey of the authors. Our readers will, of course, be chiefly interested in the report of Mr. James Fletcher, the Entomologist and Botanist of the Central Experimental Farm at Ottawa, which occupies twenty-four pages of the volume. After mentioning the chief insect attacks of the year, Mr. Fletcher gives an interesting and valuable account of the life-histories of the Hop-vine Borer (*Hydræcia immanis*, Guén.), the Red Turnip-beetle (*Entomoscelis adonidis*, Fab.) the Western Blister-Beetle (*Cantharis Nuttalli*, Say.), and the Birch Bucculatrix (*B. Canadensisella*, Chamb.); in these there is much new and original matter as well as a summary of the previous observations of others. The identification of the Hop insect, which is also called from its mode of attack the "Collar-worm of the Hop," is particularly interesting. Its injuries have been observed for more than twenty years, but it was a long time before the moth was reared from the destructive larvæ and its identity established.

The most effective remedy for this insect appears to be the encouragement of the unsavoury skunk in the hop-yards. In the northern part of the State of New York and in Wisconsin, this animal has been found most useful from its habit of digging round the infested plants and devouring the worms. The turnip and blister-beetles referred to have been very destructive in the Northwest Territories, the latter attacking the Windsor Bean, while the Birch Bucculatrix has infested the trees in the neighborhood of Ottawa. Mr. Fletcher also describes several useful parasites which serve to keep in check the currant and willow saw-flies and other injurious insects. The remainder of his report is devoted to an account of the Potato-blight, which affects the leaves of the plant and the Potato-rot affecting the tubers, and a chapter on Lawn Grasses and Fodder plants.

Catalogue of the Lepidopterous Super-family Noctuidæ Found in Boreal America. By John B. Smith, Sc.D. (Bulletin No. 44 of the United States National Museum) Smithsonian Institution, Washington, 1893.

This volume of four hundred and twenty-four pages will be heartily welcomed by every student of the Noctuidæ of North America. It is not a mere list of species but a complete bibliographical and synonymical catalogue. The authority, date and reference, are given for each genus, and under each species are given the date, author and place of publication of the original description, followed by any other publshed references, the synonymy, habitat and where the type can be found. Any one who has attempted to keep a record of the published references to our Lepidoptera—and we have all been compelled to do so in some form or other—will appreciate the immense amount of labor that Prof. Smith has performed in the preparation of this work, and must feel heartily grateful that he has now relieved us of a task that few are competent to accomplish satisfactorily. The saving of time and the satisfaction of knowing that one is not now likely to overlook anything that has been published regarding a species are no small boons to the student. For a full explanation of the origin and purpose of the work we must refer the reader to Prof. Smith's somewhat lengthy preface, which will be found well deserving of careful perusal. The general index at the end of the volume makes the work complete, and we have no hesitation in saying that it is the most useful publication on the North American Noctuidæ that has yet been issued from the press. We trust that the author will before long be able to lay us under still greater obligations to him by the publication of his contemplated monograph of the whole of this family of moths.

Brief Guide to the Commoner Butterflies of the Northern United States and Canada. By S. H. Scudder (Henry Holt & Co., 12 mo., pp. XI + 206, 1893).

It has been known for some time that Mr. Scudder has in preparation a Manual of the Butterflies of the Northern United States and Canada, similar to Gray's Manual of Plants, and all must agree that such a work is much needed. The present "Brief Guide" has, however, been produced in the meantime to meet a demand for something even less technical, by means of which boys and girls might be tempted to enter the ever charming fairy-land of science by having an easy way laid open before them. There are few objects in nature, which so soon thrust themselves upon the notice of young people as flowers and insects and of these none have been so useful as a first stepping stone or allurement to the realms of natural history as butterflies—"those winged creatures of beauty which add such a charm to the summer landscape."

There was not, however, until now, any work which could be placed in the hands of boys or girls who had caught a common butterfly, by means of which they could identify and find out something of the life-history of their newly-found treasure. This want Mr. Scudder has filled with his Brief Guide, in which he treats chiefly of those "butterflies—less than a hundred of them—which would almost surely be met with by any industrious collector in the course of a year's or two years' work in the more populous Northern States and in Canada." Should a young collector therefore be lucky enough to capture a butterfly not mentioned in the book, he may be sure that he has taken a rarity, which, as the author remarks, is "a discovery not always distressing to the amateur."

The introductory chapters, upon some of the points which will at once present themselves to a beginner are excellent—concise, clearly expressed and accurate, and treat of such subjects as :—What are butterflies, their structure, habits, variations and life-histories? There are three keys for identification, based on the perfect insect, the caterpillar and the egg, and pages 63 to 174 are taken up with short accounts systematically arranged of the insects treated of. There is a short glossary and an appendix giving instructions for collecting, rearing and studying butterflies.

On the whole this is a very useful little work, well prepared, convenient in size, well printed and well got up. It is, of course, arranged after the same system as Mr. Scudder's great work "The Butterflies of the Eastern United States and Canada," and many of the views there expressed are repeated here. The nomenclature is also the same, but the names more frequently used by other authors are also given. A good feature of the work is that the proper pronunciation of every name is shown by accents, and a popular English name is given for each species. The author's observatiens on dimorphism of some species, as of *Colias Eurytheme* and *Papilio Ajax* do not seem quite to agree with those published by Mr. W. H. Edwards. It would be difficult, however, to treat such subjects fully in the space allotted to each species in this Brief Guide, which, we think, all who use it will agree, is too brief, and they would like much more of it, of the same style. J. F.

Fig. 39.

THE LATE PROFESSOR WESTWOOD.

OBITUARY.

The Late Professor Westwood.

We are much pleased to be able to give in this issue a likeness of the very eminent entomologist, Prof. Westwood, for which we are indebted to the kindness of the publishers of the *Illustrated London News.*

John Obadiah Westwood, M.A., F.L.S., etc., was born at Sheffield, England, on the 22nd of December, 1805, and died, shortly after completing his 87th year, on the 2nd of January last. His father was a die-sinker at Sheffield, but afterwards removed to Lichfield. When nearly 16 years of age he went to London to be articled to a solicitor, and though he devoted his attention more to the study of natural history than of law, he was admitted as a solicitor and became partner in a firm. Having some private means, which he augmented by writing and drawing, he was enabled to neglect his profession and give himself up almost entirely to entomology and archæology.

To quote Mr. McLachlan's obituary notice in *The Entomologist's Monthly Magazine*, "it was probably by his rare artistic talent that he acquired much of his justly great reputation. His drawings of insects were masterpieces of accuracy without the slightest attempt at effect and rapidly executed; few have equalled him in correct delineation. There certainly never has been an entomologist, who left behind him so much evidence, in practical work, of his ability to delineate insects, even to the most minute dissections. But Westwood was much more than an artist in entomology. There probably never has existed, and in the present state of the science there never can again exist, one who had so much general knowledge, both from personal investigation and a study of the works of others: one who was less of a specialist in the modern acceptation of the term. It is true he was a specialist, but it was in the way of taking up small groups in all orders and working them out thoroughly, his artistic talent giving merit and force to those small monographs. Under a somewhat brusque manner was concealed a hearty sympathy for all real workers, and if he offended, it was commonly in the way of pointing out to would-be introducers, etc., of supposed novelties, that some one or other had already made similar observations, his vast memory rendering him very dangerous in this respect. In society there could be no more genial companion, full of anecdote, but with small appreciation of humour. At home there could be no more generous host."

Professor Westwood was best known on this side of the Atlantic from his admirable work, "An Introduction to the Modern Classification of Insects," which was published in two volumes in 1839 and 1840. Every entomologist, worthy of the name, has no doubt made a study of this book, which still continues to be the best text-book on the subject in the English language. His sumptuous works on exotic insects, such as his "Arcana Entomologica," "Oriental Entomology," and his edition of Drury's "Exotic Insects," are also widely known, but his numerous contributions to various Natural History periodicals—a mere list of which would fill a volume—are not so familiar to our students. He was a most industrious and prolific writer, and made investigations in almost every family of insects in all the orders. His work is always characterized by its marvellous accuracy and patient elaboration of details, both of structure and habit; very rarely was he ever known to make a mistake.

He was actively associated with the Entomological Society of London from its foundation in 1833, and was for many years its secretary; subsequently he was elected President at three periods of two years each, and was made Honorary Life President when the Society celebrated its jubilee in 1883. He was a fellow of the Linnæan Society from 1827 and an Honorary or corresponding member of Scientific Societies all over the world.

In 1858 the Rev. F. W Hope, a wealthy amateur, who had been for years a warm friend and patron of Westwood, and had purchased his collections, gave them and his own to the University of Oxford, and founded a Professorship of Invertebrate Zoology, which bears his name. Westwood was appointed the first Hope Professor, and in consequence removed to Oxford, where he was a conspicuous figure in the University for five and thirty years.

Besides his entomological work he was a distinguished Archæologist and was widely known amongst those of kindred tastes by his investigations of the "Palæographia Sacra Pictoria," his "Lapidarium Walliæ" and "Facsimiles of the Miniatures and Ornaments of Anglo-Saxon and Irish Manuscripts." He formed a remarkable collection of carved ivories and inscribed stones, as well as of insects In all respects he was a remarkable man, and accomplished by dint of steady industry and enthusiastic perseverance during a long life, an amount of valuable scientific work that has rarely, if ever, been excelled.

C. J. S. B.

The Late H. T. Stainton, F.R.S., etc.

Another of the leaders of English Entomology has also been taken from us in the person of Mr. Henry Tibbats Stainton, who died at his residence, Mountsfield, Lewisham, near London, on the second of December, 1892, in the 71st year of his age, after an illness of several months' duration.

His early education was received at home, and it was there no doubt, that he acquired his unusual knowledge of foreign languages which at that time were little taught in English Schools. After spending some time at King's College, London, he engaged in

business, and during the years devoted to commercial pursuits, he acquired the well-known habits of punctuality, order and accuracy, which distinguished him through life. He was always prompt in answering letters and most courteous as a correspondent. The writer had the pleasure of making his personal acquaintance at Mountsfield in 1864, and found him most kind and genial; he also met him at one or two meetings of the Entomological Society of London. Being a very energetic worker, he published a large number of articles in various Natural History magazines, and was himself the editor of the ten volumes of the *Entomologist's Weekly Intelligencer*; twenty volumes of the *Entomologist's Annual*, and joint editor from its foundation in 1864 to the end of his life (twenty-eight volumes) of *The Entomologist's Monthly Magazine*. His writings are for the most part devoted to the Micro Lepidoptera, in which group he was an acknowledged authority and possessed a world-wide reputation. Amongst his better-known works may be mentioned "Insecta Britannica Lepidoptera-Tineina," one volume, 1854; a "Manual of British Butterflies and Moths," two volumes, 1857-9, a model of clearness, conciseness and accuracy, and most useful to all collectors of British Lepidoptera; "The Natural History of the Tineina," thirteen volumes, 1855-73, printed in four languages—English, French, German and Latin—in which splendid work he was assisted by Zeller, Frey and Douglas; "The Tineina of North America," one volume, 1872, being the collected writings of the late Dr. Brackenridge Clemens, edited and annotated by Mr. Stainton; "The Tineina of Syria and Asia Minor," one volume, 1864; "The Tineina of Southern Europe," one volume, 1869.

To the *Tineina* he devoted most of his time and attention, and of them he was a diligent collector both in Britain and on the continent of Europe, and a painstaking student. The result of his work was a complete revision of the European Micro-Lepidoptera and the bringing into order and system of the various genera and species, to which little attention had been previously given. His name will long be held in high honour by entomologists everywhere, as one who devoted a long life to scientific investigation, and enriched the literature of his favorite pursuit with admirable works of great ability and unusual excellence, in which the literary portion was characterized by a charming and attractive style. C. J. S. B.

A Contrasted Summary of the Main External Characters of Butterflies in their Different Stages of Life.

By Samuel H. Scudder.

	Caterpillar.	Chrysalis.	Imago.
1. *Head as a whole* :	Independent ; a globular case, its walls but little interrupted, except by sutures.	Soldered to thorax ; mostly composed on an uninterrupted frontal plate.	Independent ; a globose case, the sides almost entirely occupied by the compound eyes.
2. Eyes :	An arcuate series of simple ocelli, on the lower portion of the sides of the head.	A slightly convex plate on each side, largely overlaid by the antennæ, leaving exposed only an arcuate band, in which are faint traces of facets.	A convex, usually strongly convex or globose mass occupying the sides, delicately and minutely facetted to form compound eyes.
3. Antennæ :	Brief, four-jointed, free, terminating in a bristle seated on the third joint.	Long, multiarticulate, folded over and appressed to the breast.	Long, multiarticulate, apically clubbed, extended, free.
4. Mandibles :	Well developed, free moving, chizel-edged or denticulate jaws.	A pair of subtriangular plates, soldered to the body.	Minute triangular immovable plates soldered to the body ; or else wanting.*
5. Maxillæ :	A papilla, seated on a mammilate elevation, with little motion.	A pair of long soldered ribbons, lying side by side along the middle line of the breast.	A free coiled tongue, composed of two opposite similarly lateral halves, the union of which, by interlocking plates on the inner surfaces, forms a hollow canal.
6. Maxillary palpi :	An inner and an outer, the former of one or two, the latter of three minute joints, seated on the crown of the maxilla.	[Not exposed on the surface.]	A single pair, at most two jointed, excessively minute, seated on the extreme outer base of the spiral tongue.
7. Labium :	Similar to the maxillæ but median, and bearing besides palpi on the outer sides, a central tube, the spinneret.	[Not exposed on the surface.]	Merely a slight chitinous ridge for the support of the palpi.
8. Labial palpi :	A minute two-jointed appendage at the outer sides of the labium.	[Not exposed on the surface, lying beneath the expanded base of the maxillæ, sheathless.]	A highly developed three-jointed appendage on each side of the head, heavily scaled, and protecting the coiled tongue, the second joint usually much the largest, the whole usually longer than the head.
9. *Thorax as a whole* :	By its contour not regionally distinct from the abdomen.	By its contour but little distinct regionally from either the head or the abdomen, but more so from the latter than from the former.	By its contour completely and equally distinct regionally from the head and the abdomen.
10. Its subdivisions :	Essentially similar, the anterior joint generally distinguished by differing armature or by the presence of extrusive glands, and always by the presence of spiracles which are wanting on the other joints.	The mesothorax much the largest, and the prothorax so reduced that its spiracles infringe upon the mesothorax, which, like the metathorax, is unprovided with them.	The proportions of the chrysalis maintained, the prothorax often becoming a mere appressed plate as seen from above, and apterous, while the other joints bear wings and lack spiracles.
11. Its surface and clothing :	More or less shagreened and bearing relatively sparse hairs, spines, tubercles or	Smooth or roughened, generally with scant and brief trichomes or none, generally	Smooth, with even surface and no elevations, but densely clothed with hairs and scales.

	fleshy filaments and sometimes extensile glands.	with abrupt elevations, particularly in the middle of the mesonotum, and at the base of the wings.	
12. Wings :	[Not visible externally, but existing as free internal membranous pads on the sides of the second and third segments.]	Folded over upon the breast as soldered chitinous pads, the front pair nearly covering the hinder.	Fully developed and free, covered with scales and often with hairs, especially at base and on the under surface.
13. Legs :	Five-jointed, tapering, smooth, partially chitinous members, no longer than the segments which bear them, and ending in a curved claw.	Many-jointed members, of which only the post-femoral parts are exposed, and of these only the first two pairs of legs (the third concealed beneath the wings) folded over upon the breast, to which they are soldered, unarmed.	Long and slender members, consisting of five very unequal parts, only the distal three elongated and the fifth broken up into five unequal joints, the last bearing a pair of claws and often other terminal structures, and at least the distal half of the whole leg more or less spined and often scaled.
14. Thoracic glands :	Very generally present as evaginable median organs on the first segment, in some cases for odorous defence, in others for unknown uses.	None known	None known, except such as have their opening in specially modified hairs or scales upon the wings or legs, when they appear to be always scent-organs.
15. *Abdomen as a whole* :	By its contour not regionally distinct from the thorax, being a succession of subequal rings, some of which bear fleshy, rather feebly jointed prolegs.	By its contour feebly distinct regionally from the thorax and at the base, beneath, overlaid by the thoracic appendages, but decidedly diminishing in size posteriorly; the position of the prolegs of the caterpillar often marked by scars.	By its contour completely distinct regionally from the thorax, with no ambulatory appendages.
16. Its surface and clothing :	Similar to that of the thorax in the same stage.	Similar to that of the thorax in the same stage, but less frequently with special elevations, though these are sometimes very marked and most commonly longitudinally disposed.	Smooth and even, without elevations, densely clothed with scales.
17. The terminal segments :	Besides an anal pair of prolegs, the upper portion of the terminal segment forms an anal plate of different form from the other segments.	Developed as a specially constructed cremaster, usually armed with hooks for the suspension of the chrysalis.	These segments are developed in the female into specially formed parts serving as ovipositor and vaginal vestibule; and in the male bear clasping organs both median and lateral of great diversity of form and armature, the latter often very complex.
18. Spiracles of abdomen:	Situated one pair to a segment on the sides of the first to the eighth segments, the last pair sometimes placed at a higher level than the others.	As in the caterpillar, excepting on the eighth segment, where the spiracles have disappeared.	As in the chrysalis.
19. Abdominal glands :	Often situated on some of the segments of the terminal half of the abdomen, either as median or paired organs, and subserving different uses, such as honey secreting or warning organs, or scent emitters.	None are known. †	Present occasionally, especially on the last two segments, generally as evaginable and odorous organs; but apparently in no case as developments of those found in the larval stage, abdominal scent organs rarely or never occurring in the same insect in two stages.

* See Kellogg's recent discussion in the Kans. Univ. quart., ii. 55.

† The chrysalis of one of the Heliconians is known to attract the attention of the mature opposite sex, but only shortly before the appearance of the imago, when any attracting odors must arise from glands, strictly imaginal, the odors piercing the chrysalis shell.

TWENTY-FIFTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF

ONTARIO

1894.

(PUBLISHED BY ONTARIO DEPARTMENT OF AGRICULTURE, TORONTO.)

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY.

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TORONTO:
WARWICK BROS. & RUTTER, PRINTERS, &c., 68 AND 70 FRONT STREET WEST.
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PROFESSOR WILLIAM SAUNDERS, F.R.S.C.

Director of the Experimental Farm of the Dominion of Canada. President of the Entomological Society of Ontario, 1875-86. Editor of "The Canadian Entomologist," 1874-86.

AUGUSTUS RADCLIFFE GROTE, A.M.,

Honorary Member of the Entomological Society of Ontario (Elected Nov. 10, 1868); Vice-President of the American Association for the Advancement of Science, (1878), etc., etc.

TWENTY-FIFTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY OF ONTARIO

1894.

To the Honorable the Minister of Agriculture:

SIR,—I have the honor to submit for your approval the twenty-fifth annual report of the Entomological Society of Ontario. The Council feels a pardonable pride in drawing your attention to the fact that they have now completed a quarter of a century's work in the investigation of the life histories of insects and their relation to agriculture and horticulture, and have embodied the results of their researches in twenty-five annual reports and twenty-six volumes of the *Canadian Entomologist*. This somewhat uncommon success in the case of a voluntary scientific society is, they feel, largely due to the support which has been received from the Legislature of Ontario, and for which they desire to record their grateful thanks.

The President's address and the various papers on economic and general entomology which are contained in the accompanying report will be found, it is trusted, as interesting and as useful as on previous occasions.

I have the honor to be, Sir,

Your obedient servant,

W. E. SAUNDERS,

Secretary.

OFFICERS FOR 1895.

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" 4	A. H. KILMAN	Ridgeway.
" 5	R. W. RENNIE	London.
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ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY.

The thirty-second annual meeting of the Entomological Society of Ontario was held in its rooms in Victoria Hall, London, on Wednesday and Thursday, November 7th and 8th, 1894, the President, Mr. W. H. HARRINGTON, F.R.S.C., of Ottawa, occupying the chair.

The meeting was called to order at 3 o'clock p.m. on Wednesday, when the following members were present: Rev. T. W. Fyles, South Quebec; Mr. H. H. Lyman, Montreal; Mr. James Fletcher, Ottawa; Rev. C. J. S. Bethune, Port Hope; Capt. Gamble Geddes, Toronto; Messrs. J. M. Denton, J. A. Balkwill, W. E. Saunders, J. A. Moffat, J. W. Dearness, W. Stevenson and H. P. Bock, London. A letter of apology was read from Mr. J. D. Evans, of Trenton, regretting his inability to attend the meeting.

After discussing the question of obtaining more suitable and commodious rooms for the society, which was also considered at the evening session, the first paper on the list was read by Capt. Geddes on "Some of the Insects of Bermuda collected during the Winter of 1893-4." The writer brought a number of interesting specimens to illustrate his remarks. Observations were made upon the paper by Dr. Bethune, who had visited the islands during the two previous winters and had found very few insects of any kind; the only butterflies he saw were *Danais Archippus* and *Junonia Cœnia*, a few Geometer moths and Plusias flying about the lantana blossoms at dusk, and some beetles of the family Scarabaeidæ. As Capt. Geddes's visit had extended over four months his opportunities were very much greater and he had succeeded in making a very interesting collection.

Capt. Geddes gave an account of a remarkably late brood of the Camberwell Beauty butterfly, *Vanessa Antiopa.* He found the larvæ feeding on the yellow and partly faded leaves of a young elm tree in his garden, which they nearly stripped of its foliage; many of the caterpillars fell to the ground with the falling leaves on which they fed. The butterflies from this brood came out in the house on the 6th and 7th of November.

Mr. Lyman gave an account of his observations of the various broods of *Vanessa Milberti*. Hibernated specimens of the butterfly appear in early spring; the first brood from these was flying on the first of July, and colonies of larvæ were found feeding on nettles early in the month. Very young larvæ were found again on the mountain at Montreal on the 20th of August; these became full grown on the 13th of September and changed to pupæ on the 18th. Late in October the full colors of the butterfly were showing through the chrysalis case, but when he left home on the 5th of November, the butterflies had not emerged. Mr. Scudder, in his work on butterflies, states that this species has three broods in the New England States. Mr. Lyman thought that those now in the pupa state were the third brood at Montreal.

Dr. Bethune exhibited some specimens of rare Lepidoptera that he had taken this summer. Among them were *Limenitis Proserpina*, captured at Roach's Point, Lake Simcoe, on the 22nd of August; *Sphinx luscitiosa*, attracted by light at Port Hope, in June; a variety of *Catocala ilia* taken at sugar in July; *Plusia venusta*, Walk. (*striatella* Grote), attracted by light; an immaculate specimen of *Pieris rapæ*, etc. Mr. Fletcher stated that *L. Proserpina*, though excessively rare, had been taken at Rideau Hall, Ottawa.

Mr. Lyman read an interesting paper on "Common Names for Butterflies, Shall We Use Them?" In the discussion that followed Mr. Fletcher stated that common names would be given for all the Canadian species of butterflies in the handbook that he and Dr. Bethune were preparing for publication. The general opinion of those present was that it is highly desirable that ordinary English names should be used as far as practicable in order to promote the study and observation of insects.

Dr. Bethune then read "A List of the Butterflies of the Eastern Provinces of Canada," which contained no less than 116 species, of which the localities and in most cases the food plants and times of flight were given. The paper was commented on by Capt. Geddes, Messrs. Fletcher, Fyles and Lyman, who contributed much interesting information regarding a number of the species.

Mr. Fletcher exhibited specimens and gave an account of the remarkable habits of the moth *Exyra Rolandiana*, the larva of which feeds upon the leaves of the pitcher plant, *Sarracenia purpurea*. He also exhibited an interesting collection of butterflies sent by Mr. Green, of British Columbia, and gave an account of a visit he made to Sudbury in May last, when, notwithstanding a snow storm that prevailed, he procured the larva of *Pamphila metacomet*, which fed on carex, and which he succeeded in rearing He made some interesting remarks upon *Colias elis*, *nastes* and *interior*, and gave an account of a rearing of *Colias eurytheme*, the eggs of which he had obtained at Nepigon in June. When the chrysalids were beginning to show the color of the butterfly he retarded their development for some weeks by placing them in a refrigerator, while emergence was hastened by exposure to electric light. He also showed some specimens of *Papilio Bairdii* and *P. Oregonia* received from Mr. Edwards, who had this year added yet another to his laurels by proving that these very dissimilar butterflies were really dimorphic forms of one species. Mr. Edwards had gone to Colorado and with great care had bred broods of larvæ from eggs laid by both forms and had obtained from each brood some of both kinds of the butterflies named. This, the speaker said, he considered one of the greatest triumphs of this wonderful man. He had had the great pleasure of meeting Mr. Edwards in his own beautiful home amongst the mountains of West Virginia, where he hoped he would long be spared to carry on his useful studies with his characteristic energy, perseverance and accuracy.

Mr. Fletcher next exhibited specimens of *Pamphila metacomet* in all stages, egg, larva, pupa and cocoon and perfect butterfly, as well as an egg parasite, which had been named by Mr. Ashmead *Telenomus pamphilæ*, n.s. It was agreed at the last annual meeting that each member should try to work out the life history of at least one insect in time for this meeting : he had devoted his attention to *P. metacomet*, which is as a rule rarely taken at Ottawa. This fact, however, he thinks has been due to a want of knowledge as to its habits. He had previously taken the butterfly only in open glades in a wood, but the larvæ feed on carices growing on exposed rocks. The food plant of this species as well as that of *P. mystic*, which he had also bred this year, was, he thought, not grasses, but sedges (carex), although in confinement they would eat grasses. The eggs are laid in July and the caterpillar passes two or sometimes three moults the same autumn and then hibernates in a case made by spinning three or four of the leaves of the food plant together. The larva is pale green, closely lined all over with broken white lines and covered with minute black piliferous tubercles. The most remarkable part of the larva is the head which is ornamented differently from that of any other species of the genus he was acquainted with. On the front, at the apex, is a large, velvety black area edged with white, and down either side of the face run two white lines with a dark area between them ; behind these lines the head is black. The thoracic shield is ribbon-like, double, white in front, black behind. Just previous to pupation two large, white patches were plainly visible through the skin beneath segments 11 and 12. When ready to pupate the larva spins a close cocoon, similar to that of *Acronycta oblinita*, the end of which is stopped up with a silvery white, flakey powder which is emitted through the skin (apparently) from the two white patches mentioned. In three or four instances the pupa worked its way out of the cocoons and fell to the ground. It is piceous, when cleaned of the white silvery powder, slender and much elongated. The tongue case protrudes beyond the wing cases as in *Pamphila cernes*, etc. The abdomen beneath is closely covered with tawny bristles which are thickest at the cremastral end. The end of the body is furnished with about six short blunt spikes and on each side two larger ones. A more detailed account of the stages will appear later in the *Canadian Entomologist*.

The Rev. T. W. Fyles read a short paper on "*Catastega aceriella-Semasia signatana*." In answer to an enquiry whether *Nematus Erichsoni*, the Larch saw-fly, was

still at work, he stated that it was still operating in the Province of Quebec, but in greatly reduced numbers. A tree here and there had been stripped this summer; in some cases part of the tree only had been affected. The insects were now attacking young trees—those from about ten to twenty or more feet in height. They seemed on their first arrival to pass by these, he supposed because the foliage of the more mature trees was more palatable to them. Some trees near Quebec that had been badly attacked and that he once thought would die, seemed to have made a struggle for life and had sent out numbers of small twigs on the stems and main branches, so as to present a very scrubby appearance. He had not been able to visit the large swamps in the Townships, but he believed the state of things there to be such as he had described in the society's Reports. He had been surprised to find in parts of the Gomin swamp affected by drainage numbers of small tamaracks from six inches to several feet high, where a few years ago none were to be seen. Mr. Harrington stated that in Cape Breton also he found young tamaracks growing up.

Mr. Fyles next gave an account of a strange food for the larvæ of *Pyralis farinalis.* He said that in the society's Report for 1893, page 42, he gave a description of a *Lithocolletis* larva that he found feeding in blisters on the leaves of the white hazel, and which he hoped to rear. When full fed the larva spun a cocoon inside the blister, but his hope of obtaining the perfect insect was defeated in a strange manner. One the 3rd of March he examined the glass jar in which he had stored the blistered nut leaves, and over which he had tied a muslin cover. To his great surprise he found a number of Pyralid larvæ feeding upon the leaves. He described them as follows: Length, when extended, nine-tenths of an inch; head and prothoracic and anal plates, nut brown; the rest of the body, lead color; dorsal line, black. The appearance of the larvæ seemed familiar to him, but he let them be. They ate up the nut leaves, leaving only a tangle of the ribs and veins. In due time they produced a number of fine specimens of the moth *Pyralis farinalis*, Linn.

Mr. Fyles stated that he wished to rectify a mistake. In the list of captures on page 41 of the annual Report for 1893 occurs the name *Anisota senatoria*; it should be *Anisota virginiensis*, Drury.

Mr. Harrington exhibited a collection of beetles from Japan, many of which were very beautiful and remarkable.

Mr. Lyman showed a box of specimens collected by Mr. Bean, at Laggan, Alberta, among which was a series of the moth *Nemeophila petrosa.* An excellent photograph of these had been made, and it was resolved, on motion of Mr. Fletcher, seconded by Dr. Bethune, that Mr. Lyman be requested to have a plate prepared for publication in the *Canadian Entomologist.*

Mr. Fletcher exhibited a small collection of diurnals which had been sent down for identification by Mr A. W. Hanham, of Winnipeg. Attention was drawn to specimens of *Thymelicus Garita*, this being probably the most eastern record: *Lycæna Melissa*, *Thecla Acadica* and three specimens of *Thecla strigosa*, all of which showed the large fulvous spots similar to the specimen figured by Boisduval and Leconte as *T. Liparops.* This form was very rare at Ottawa, the speaker having taken only two specimens in many years.

While on his feet Mr. Fletcher said he wished to mention that a good deal of work had been done during the past season in collecting insects in distant places in Canada

Mr. A. P. Low, of the Geological Survey, had made a collection of diurnal Lepidoptera and Coleoptera in his journey across Labrador, specimens of *Pyrgus centaureæ*, *Chionobas jutta* and *Colias Scudderii* were exhibited. Dr. G. M. Dawson and Mr. J. McEvoy had collected in the mountains about Ashcroft, B.C.; Messrs. C. de B. Green and Edmund Reynolds had made large and valuable collections of Lepidoptera in the mountains at Osoyoos, B.C., just north of the boundary of Washington State. Specimens were exhibited of *Papilio Daunus*, *Oregonia*, *Rutulus var Arizonensis*, *Turnus*, *Satyrus Œtus*, *S. Ariane*, *Lycæna sagittigera*, *L. Heteronea*, *Pieris Beckerii*, *Colias Emilia*, *Anthocaris Sara*, *A. creusa*, *Thecla dumetorum*, *Pterogon Clarkiæ* and many other

rarities. Mr. Fletcher was glad to be able to announce that Mr. Green intended next year to collect as a business. His address for the present is Osoyoos, B.C., and intending purchasers would do well to correspond with him at once. Mr. Green and Mr. Reynolds had both added new species this year to the Canadian list. At Calgary Mr. C. Wolley-Dod had done good work in collecting and providing Mr. W. H. Edwards with eggs of *Chionobas Alberta*, the larvæ from which had been successfully taken through all their stages. At Olds, 40 miles from Calgary, Mr. T. N. Willing had also done good work, and had taken, among other rarities, *Erebia discoidalis* and *Argynnis Edwardsii*. Prof. John Macoun had this year collected at Crane lake, in the same district, and had added *Hipparchia Ridingsii* to the Canadian list. In Alaska collections of insects had been made by Messrs Otto Klotz and W. Ogilvey, of the Boundary Survey, as well as by some of the other members of the party This material was chiefly diptera, coleoptera and hymenoptera. It had not as yet been worked up. In the Rocky Mountains Mr. T. E. Bean continued his studies. Through his kindness eggs had been received by the speaker of *Colias Elis*, of which bred specimens of the larvæ and imago were exhibited, *Colias nastes* and other rare species. Some beautifully blown larvæ prepared by Mr. Bean were shown. Mr. W. McInnes and Mr. J. C. Guillim, of the Geological Survey, had collected east of Port Arthur, the latter gentleman taking *Euptoieta Claudia* at Wabigoon, on the C. P. Ry. In Manitoba collections had been made by Mr. Hanham at Winnipeg, and a very remarkable collection by Mr. E F. Heath, near Cartwright, Man., some most surprising captures had been made as *Vanessa Californica*, *Nathalis Iole*, and a Thecla which is probably undescribed. Mr. Heath has also sent the cocoons of some splendid specimens of *Samia Columbia* which were exhibited, and compared with specimens found at Ottawa on tamarack. The northwestern food of this species is *Elæagnus argentea*, and the moths are always distinguishable by their much redder hue.

Mr. Harrington gave some interesting "Notes on Canadian Coleoptera," relating how he had obtained a hair-snake from a Coccinella, and found the larvæ of a beetle, *Brachyacantha ursina*, feeding upon plant lice in an ant's nest, with other noteworthy matters, which will be found detailed in his paper.

The meeting adjourned at 6 o'clock p.m.

EVENING SESSION.

In the evening the society held a public meeting in its rooms in Victoria Hall, at which there was a largely increased attendance of members, between thirty and forty being present. Besides those already mentioned at the afternoon meeting, the following were noticed: Messrs. R. W. Rennie, J. G. Wilson, J. H. Bowman, Dr. S. Woolverton, J. H. Pearce, W. T. McClement, W. Scarrow, etc.

The chair was taken by the President, Mr. Harrington, at 8 o'clock. After apologizing for the absence of Mr. Kilman and Mr. Evans, the Chairman called upon the Secretary to read the

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario beg to present the following report of their proceedings during the past year:

They are happy to congratulate the members of the society upon the steady increase in numbers which continues to take place, and the hearty interest that is maintained in the various departments of work.

The twenty-fourth annual report on Economic and General Entomology was presented to the Minister of Agriculture in November last, and was printed and distributed at the beginning of January. It consisted of one hundred and eleven pages, a much larger number than usual, and was illustrated with thirty-nine wood cuts and a portrait of the Editor, who was for several years President of the society. Among the more important and interesting papers may be mentioned Mr. Fletcher's account of "The Injurious

Insects of the Year 1893"; the President's Address; "Entomological Mistakes of Authors," by the Rev. T. W. Fyles; "Mosquitoes," by Mr. Moffat; "Dragon Flies," by Mr. McLaughlin; "A Contrasted Summary of the Main External Characters of Butterflies in Their Different Stages of Life," by Mr S. H. Scudder, and a report of the fifth annual meeting of the Association of Economic Entomologists, together with a number of the principal papers.

The *Canadian Entomologist*, the monthly magazine published by the society, has been regularly issued at the beginning of each month, and completed its twenty-fifth volume in December last. It consisted of 334 pages, being the largest number yet published. Of the twenty-sixth volume eleven numbers have already been issued; the increase in the number of pages has been more than maintained, 328 having been already published. No less than fifty-two wood cuts have been used to illustrate papers, a large proportion of them being new and original. Among the many valuable and interesting papers that have been published, mention may especially be made of the series of illustrated articles on the "Coleoptera of Ontario and Quebec," by Mr. Wickham, which are intended especially to assist beginners in naming their specimens, and to lead them on to a more thorough study of the order. The list of contributors includes the names of the most eminent entomologists in North America, as well as several in Europe.

The collections of specimens belonging to the society have been increased during the past year by the addition of a number of coleoptera new to the Canadian lists by Mr. A. H. Kilman, of Ridgeway, and a collection of insects from San Domingo. Improvements are also being steadily made by the substitution of fresh specimens for those that are faded or imperfect in the cabinets.

The geological, microscopical and botanical sections of the society have held regular meetings during the past season and have done much good work, as is shown by their respective reports. It is to be regretted that the ornithological section has not been so active as in former years, but it is trusted that interest in this department will speedily be revived.

The treasurer's report is highly satisfactory. The expenditure on the *Canadian Entomologist* has necessarily been increased by its enlargement, but this has been fairly met by the steady growth in the number of subscribers and by the sale of back volumes. The balance on hand at the close of the financial year is $360.50. This will be entirely absorbed by the necessary expenses of the remaining months of the year. The Council take this opportunity of recording their appreciation of Mr. Balkwill's services as treasurer and the satisfactory mode in which his accounts are kept.

The society was represented at the annual meeting in Ottawa of the Royal Society of Canada, in May last, by the Rev. T. W. Fyles. We have much pleasure in recording that two of our members were elected fellows, namely, our President, Mr. W. H. Harrington, and the Rev. G. W. Taylor, of Nanaimo, B.C.

All of which is respectfully submitted.

W. E. SAUNDERS,
Secretary.

REPORT OF THE LIBRARIAN AND CURATOR.

Mr. J. A. Moffat presented and read his report as follows:

I beg leave to submit my report for the year ending 31st of August, 1894.

Seventy-seven volumes have been added to the Library during the year; these include bound volumes received from public institutions and scientific societies, exchanges collected and bound, also books obtained by purchase.

The more important of the bound volumes received are, The Reports of the Missouri Botanical Garden for the years 1891 and 1893.

Annual Report of the Ontario Department of Agriculture for 1892.

The Smithsonian Report for 1891.

Report of the New York State Entomologist for the years 1891 and 1892.

Report of the New York Agricultural Experiment Station for 1892.

Reports of the New York State Museum for the years 1892 and 1893.

Proceedings and Transactions of the Royal Society of Canada for 1893.

Iron-bearing Rocks of Minnesota.

Added by purchase: A popular handbook of the Ornithology of the United States and Canada, based on Nuttall's Manual: by Montague Chamberlain, 2 volumes. All the Entomological writings, up to date, of J. W. Tutt, F. E. S., England, editor of "The Entomological Record and Journal of Variation." Also his instructive and amusing book entitled, "Random Recollections of Woodland, Fen and Hill"; seven volumes in all. These were obtained in exchange for back volumes of the *Canadian Entomologist.*

There are now four hundred and eighty-five pamphlets in the Library, bound in twenty-seven volumes. These volumes are labelled "Pamphlets," and numbered consecutively from 1 to 27, but have their number in the Register according to the time they were bound and placed in the Library. The pamphlets are numbered in order, and catalogued in a book by themselves, giving the Library number as in the Register, the number of the pamphlet volume, the pamphlet number, with the author's name, the subjects, and the date of issue where obtainable.

The whole number of volumes on the Register is now 1,361. The number of volumes issued to local members during the year was forty-four.

Additions are still being made to the Society's collection of native lepidoptera by the capture of species hitherto unrepresented therein; twenty named forms being added during the year, which had not before been published as Canadian. There are now 1,077 named forms in this department, as against 930 in 1892. A steady improvement in the quality of the collection is also being made by the replacing of such as are not in perfect condition, with fresh material obtained by capture or exchange.

The first important addition to the Society's collection of native Coleoptera for several years was made by Mr. A. H. Kilman, of Ridgeway, Ont., in a donation of a hundred and fifty species.

A small but highly interesting collection of Santo Domingo insects was presented to the Society by a friend, the captures of his sister, Miss Davida Rougoie, who is at present a resident of that island. The most noticeable feature of it being three specimens of *Mantis* of strikingly different form, color and ornamentation, indicating that it is an abundant family in that locality.

Through the kindness of Mr. A. P. Morse, of Wellesley College, Mass., the Society has been put in possession of representative specimens of three species of New England *Spharagemon*, also his paper, historical and descriptive, of the same.

All of which is respectfully submitted.

J. ALSTON MOFFAT,
Librarian and Curator.

The President then read his annual address, which was listened to with great interest and attention:

ANNUAL ADDRESS OF THE PRESIDENT.

BY W. HAGUE HARRINGTON, F.R.S.C., OTTAWA.

"An ant slow-burrowing in the earthy gloom,
A spider bathing in the dew at morn,
Or a brown bee in wayward fancy borne
From hidden bloom to bloom."

—*Lampman.*

GENTLEMEN,—My first duty to the members of the Entomological Society is to sincerely thank them for the honor which they conferred upon me in re-electing me to be their President, notwithstanding my inability to be present with them at the last annual meeting. Those among you who may afterwards have read my address, as printed in the Annual Report, may perhaps have congratulated yourselves that I did not appear at the meeting and read it to you in extenso. You need not, however, be alarmed lest you have to listen to such an over-lengthy document on this occasion.

My good friend, Mr. Fletcher, has kindly consented to address you on the injurious insects of the past season, and thus I am relieved of a task for which he is more competent, and for which his official duties so fully qualify him You shall, I rest assured, find his remarks to be most interesting and profitable to you, both as regards economic and scientific questions.

The Report prepared by the Council will inform you as to the work performed by the Society during the year, and as to its present financial standing and prospects, so that, with regard to these points, I need merely express my sense of a lively satisfaction in the knowledge that continued prosperity and success crown the efforts which you are making to advance an interest in, and a truer knowledge of the attractive and deeply interesting science of entomology, for the study of which you have been banded together for so many years.

After careful consideration of several topics which occurred to me as worthy of your attention, I decided that a brief review of the results of the past twenty-five years might not be unprofitable. I shall base my remarks upon the volumes of the *Canadian Entomologist*, and shall afterwards endeavor to indicate the direction in which future work may be advantageously undertaken. The splendid series of twenty-five volumes of the *Canadian Entomologist*, which have already been completed, constitute a veritable treasure-house of information regarding the insects of North America. The value of their pages has been greatly increased by the constant contributions from the leading entomologists of the neighbouring Republic, and by frequent articles from European correspondents. The valuable papers received from these sources have dealt largely with the Canadian fauna, and have often been based upon the captures of our members in Canada, but my present remarks will be confined to a discussion of the work of our home members as recorded by themselves. These laborers have ever been few in proportion to the vast extent of country of which it is our privilege and duty to investigate the insect life. We need not be surprised, therefore, because the investigated districts are very limited in comparison with the still unexplored fields which are waiting to yield up their treasures to the careful investigator. The areas in which systematic and sustained work has been done are, in fact, so few and so limited in extent, that on a map they appear almost as mere starting-points.

It is worthy of note that the labors of editing the twenty-five volumes of the *Entomologist* have devolved equally upon Prof. Saunders and Dr. Bethune; each of these gentlemen having edited twelve volumes and shared in the editing of volume eighteen. The Society has owed much to the zeal and work of these gentlemen, whose contributions appear in nearly every volume, and much exceed the efforts of any other member. Among their contributions are many valuable papers on our lepidoptera, containing descriptions of their earlier stages, and also of some new species. Another series of very interesting and valuable papers was that "On Some of our Common Insects," designed to arouse the interest of some of those who might be taking up the study of entomology,

and to stimulate them to become earnest workers. We are glad to know that these learned friends, who have, in the past, done so much for our Society and for the study of entomology, are still connected with us in the work which we are carrying on. Dr. Bethune continues to be our efficient editor, and under his wise and careful direction our publication continues steadily to improve, and to hold a foremost place in entomological literature. Prof. Saunders, although called to a position making great demands upon his time and strength, still keeps up his interest in our special line of scientific work. A few years ago he embodied his researches in that excellent treatise on "Insects Injurious to Fruits," which, since its appearance, has been a standard work, and has had a very large circulation throughout North America.

One of the most useful and important features of the earlier volumes was the compilation by Dr. Bethune, from Kirby's Fauna Boreali-Americana, of the "Insects of the Northern Parts of British North America" (afterwards republished as a separate volume), which placed the descriptions of a great many of our insects in the hands of students who might not otherwise have been able to obtain them, the original publication being very rare.

Before commencing this address I made a list of some fifty Canadian contributors, the majority of whom still continue to send in valuable papers. Several, however, have passed to the "Happy Hunting Ground" beyond the "Great Divide," while others have either removed from the Dominion, or through pressure of business and new occupations, have ceased to contribute; though in some cases still keeping up their collections and their interest in the study and work of the Society. My intention is not to go at length into the writings of individual members, nor can I make any reference to the many valuable papers specially prepared for the Annual Reports furnished to the Ontario Government. But I shall try to bring my subject before you in two ways: first, from a geographical standpoint, that you may see in what districts our insects have been studied; secondly, from a systematic point of view, that you may see which orders have received attention, and which have been, in whole or in great part, neglected.

As our Society is provincial, in so far as regards its name and the liberal support which it annually receives from the enlightened Legislature of Ontario, so the larger portion of the work accomplished by it has naturally related to the insects of the Province in which it was organized and by which it is sustained. A good starting-point for our proposed tour of inspection will be London—the beautiful city in which we are now met, and which, as the headquarters of the Society, has been for many years the Entomological Mecca to which we annually resort to renew our strength and zeal in the good work, and to arrange our plan of campaign for the coming year.

Here Prof. Saunders toiled for many years, and, with the later assistance of his sons, made most extensive collections. His papers do not, however, include any lists of the species which he collected in the various orders, and the same remark may apply to Messrs. Denton, E. Baynes Reed, Williams and others whose captures have so largely enriched the collections of the Society. The London members, however, had for many years almost the entire management of affairs of the Society, and the preparation of the Annual Reports, the arrangement of the collections, the care of the library, etc., occupied much time that might otherwise have been devoted to special lines of research.

At Grimsby Mr. J. Pettit, in the earlier years of the Society, was a very skilful and assiduous collector, and his list of the coleoptera taken in that neighborhood, which he commenced in the first volume, is one of the most complete local catalogues yet published in Canada. The Hamilton district has been investigated by such competent collectors as Messrs. Moffat, Murray, Johnston and Hanham. The first of these gentlemen has made many valuable contributions to our publications, and is now continuing his good work in London, where he has the charge of the collections and library. Mr. Geo. Norman, of St. Catharines, published a very interesting list of the Noctuidæ captured there by him. At Ridgeway we find a member of our Council, Mr. A. H. Kilman, who has made extensive collections in what seems to be a very rich district; but while he has added largely to the knowledge of our insects, he has not yet published as much regarding them as we should like him to do.

Toronto, as the chief City in Ontario and the seat of various and important institutions of learning, should furnish us many capable investigators, but I find that the workers there have never been numerous; nor do the local natural history societies appear to have done much to develop them. I must mention, however, our first President, Prof. Croft, with Mr. W. Brodie and Capt. Gamble Geddes. Mr. Brodie has accumulated large collections, and he has published a few interesting articles in our magazine (and more recently in the "Biological Review of Ontario,") upon various gall-forming insects. Capt. Geddes has been a most enthusiastic gatherer of lepidoptera, amassing a collection of butterflies unequalled in Canada, and which has since been purchased by the Geological Survey of Canada. His interesting papers upon Canadian butterflies appear in several volumes of the *Entomologist.*

Port Hope has been the home of Dr Bethune, so we may rest assured that the country round about has been well investigated. I have not yet had the pleasure of seeing his fine collections, and as regards the extent and value of his writings upon our insects I have already spoken. At Belleville we have had such well-known collectors as Prof. J. J. Bell and Prof. Macoun. The former paid much attention to the smaller forms of coleoptora, and was a frequent contributor to the *Entomologist.* As for Prof. Macoun, he is now a naturalist of world-wide reputation, who has been most assiduous in making known the fauna and flora of the Dominion, and although the great demands upon his time do not permit him to continue the study of entomology, he still continues, I am glad to say, the collection of insects as opportunity permits. In the neighboring town of Trenton very careful work has been done by Mr. J. D. Evans, one of the most thorough collectors with whom I have corresponded, and whose collections are models of neatness and skill, in mounting and arrangement.

A branch of the Society formerly existed at Kingston, but I do not find the record of any work except by Mr. R. V. Rogers, from whom we have had several interesting papers. With such a well-known university as Queen's located in the city, there should be more activity in the development of the natural history of the locality. Ottawa in the early days of the Society was the residence of one of our most noted collectors, the late Mr. B. Billings, who was a contributor to Vol. I. His collections were extensive and were very carefully and skillfully prepared, but death cut short his labors, and his collections were mostly destroyed through want of proper care on the part of the Society into whose hands they passed. Of recent years there has been an active, if not large, body of investigators, who have striven to develop a full knowledge of the local fauna, and who have been able to do some useful work in other directions. Prof. Saunders is now there, as Director of the Experimental Farms, in connection with which our good friend, Mr. Fletcher, holds the position of Entomologist and Botanist. The value and authority of his official work, and his enthusiasm in all entomological matters, are recognized by every entomologist. Your out-going President is also to be found in the Capital, when at home, but it would not be quite the correct thing to give any opinion on his work, as you might think me a prejudiced judge. The Ottawa Field-Naturalists' Club, organized in 1879, has always had an Entomological Branch, and several other of its members are doing fair work, among whom I may cite Mr. T. J. MacLaughlin, one of the few collectors of odonata in Canada. Several entomological lists, with numerous reports and papers have been published in the *Transactions* of the Club (now the *Ottawa Naturalist*), and Mr. Fletcher has now ready for publication a complete catalogue of the Ottawa butterflies.

Occasional workers have been stationed at other points, as, for instance, Rev. V. Clementi at North Druro, Mr. N. H. Cowdry at Stratford and Mr. B. Gott at Arkona. In the Lake Superior region the only sustained work has been by Mr. Evans at Sudbury, where he made a most interesting, and fairly complete, collection in several orders. Many rare insects have been captured by him and it is much to be regretted that he has not yet found time to publish the lists which he has had in preparation. Nepigon has several times been visited by Mr. Fletcher, and in one of the annual reports can be found an interesting account of the work done there. Dr. Bethune has also published observations made during a trip to Lakes Huron and Superior.

In the adjoining Province of Quebec we find the work of the Ottawa members naturally extending across the Ottawa river to a country which within a few miles is diversified by outlying spurs of the Laurentians, with some consequent change in the flora and fauna. A strong branch of our society is located in Montreal where much effective work has been done by the resident entomologists. It is only a few years since the branch sustained a great loss in the death of their former President, Mr. Bowles, who had made a study of the lepidoptera of the Island of Montreal, and had written frequent papers on the species collected. Mr. Lyman, who I am glad to see with us to-day, has for several years been the President and has shown great interest in its success, and in the continuance of its meetings. He has made a careful study of the lepidoptera, and has accumulated a splendid collection, while his contributions to the *Entomologist* have been numerous and of unusual interest. The late Mr. Caulfield was an industrious collector, and careful observer, who contributed severable valuable lists and other papers, relating chiefly to the insects of the Island of Montreal. Another member who resided there was the late Mr. W. Couper (also of Quebec and Ottawa) a frequent contributor to our earlier volumes. Among other Montreal workers may be mentioned Messrs. Jack, Winn, Hausen, Gibb, Wintle, etc. The Natural History Society has always taken some interest in entomology, and on its annual field-day encourages by suitable prizes the collection of insects by the young people. The *Canadian Naturalist and Geologist* and its successor the *Canadian Record of Science* have from time to time published entomological papers, such as the late Mr. Ritchie's list of local coleoptera, Mr. Caulfield's paper on Canadian orthoptera, and Mr. Hausen's list of coleoptera collected at St. Jerome.

Going down the St. Lawrence we reach Quebec, the scene for many years of the labors of the late Abbe Provancher, whose Faune Entomologique is a monument to his industry and perseverance in the collection and study of our insects, under more than usual difficulties and discouragements. Mr. Bowles and Mr. Hanham also formerly resided in Quebec, and at present we are well represented there by the Rev. T. W. Fyles, a very industrious observer, who has frequently charmed us by the scholarly papers read at these meetings, to be present at which he does not hesitate to take the long journey from the Ancient Capital. The late Mr. Couper made collecting trips to Anticosti and the shores of the Lower St. Lawrence, the results of which appeared in our earlier volumes.

In the Maritime Provinces our only contributors appear to have been Mrs. Caroline E. Heustis of St. John, N.B., and Mr. J. Matthew Jones of Halifax, N.S. The catalogues of the British Museum and other scattered entomological literature show that considerable collections have been made in those provinces, chiefly by officers of the army and navy, and it is matter of regret that there are no resident entomologists, to make a closer study of the insect life, which my own occasional observations prove to be very interesting in many particulars.

Turning westward again to that immense country which stretches from our fair province to the far Pacific, the localities which have been investigated are almost lost in the vast expanse of yet unexplored territory. Mr. Hanham, who formerly collected in Ottawa, Hamilton, Paris and Quebec, has recently removed to Winnipeg, and intends to devote every opportunity to making known its insect life. Capt. Geddes a few years ago made most valuable collecting trips across the prairies and to the Rocky Mountains, and at Laggan, Alta., Mr. Bean is industriously collecting, and adding to our knowledge of the mountain fauna. Both of these gentlemen have, however, devoted themselves chiefly to the study of the lepidoptera, and we have yet to wait for resident entomologists, stationed at moderate distances apart, to gain an adequate idea of the general distribution of the insects of all orders.

On the Pacific coast the Canadian gleaners are also few, although a rich and abundant insect life rewards the labors of the collector. Our chief worker has been the Rev. G. W. Taylor, who has made large collections of lepidoptera, hymenoptera and coleoptera, including many species new to science. These collections were chiefly made in the vicinity of Victoria, V.I., but Mr. Taylor has recently removed to Nanaimo, and

has thus a new field of investigation open to him. Mr. W. H. Danby of Victoria is also an energetic collector, and our former associate in the Council, Mr. E. Baynes Reed, now resides at Esquimalt, a few miles from Victoria, and although he has not yet sent to us any account of his work, I know that he is making collections. The recent organization of a Natural History Society in Victoria may stimulate a further interest in Entomology, indeed I believe that a catalogue of the butterflies of Vancouver Island has already been published in the transactions of the Society. Several hundred miles to the north, at Masset in the Queen Charlotte Islands, there is a very careful and competent collector, the Rev. J. H. Keen, who in this farthest outpost has made most interesting discoveries, especially in coleoptera.

A considerable knowledge of the insects of the remoter regions of the Dominion has resulted from the collections made by various members of the staff of the Geological Survey ; prominent among whom may be mentioned Dr. Dawson, Dr. Bell and Prof. Macoun. There has not yet been any regular entomological work done in connection with the Survey, and it cannot be expected that the collections of insects, which are made in addition to the regular field work, should be very large or comprehensive. But our thanks are no less due to the gentlemen who have aided ; for even a few specimens brought in occasionally, from the distant points reached by these explorers, may do much to help in ascertaining the geographical range and distribution of species. Reference to Volume XXII of the *Entomologist* will show that quite a long and useful list of coleoptera was obtained by collating the various short lists published in the Survey Reports. When the Dominion Museum is housed in correspondence with the value of its great collections, and room is afforded for the display of the natural history specimens collected, the explorers will feel a greater interest in the securing of specimens, and a department of entomology will probably soon be installed.

Having now made a rapid, and necessarily imperfect, survey of the districts which our members have explored in the past, or which they are still investigating, let us change our point of view, and, for a few moments, consider what attention has been bestowed upon the several orders, into which it has pleased systematic entomologists to separate the great and almost inexhaustible complex of minute forms, which are known to us under the general term Insects. From the twenty-five volumes of the *Entomologist*, I have made a list of the papers which seemed to me to be of most importance in helping us to a knowledge of the position of our workers in regard to the investigation of the several orders. The list (appended) is by no means a complete one, as numerous short papers, notes on the occurrence of species, and interesting correspondence have been omitted ; my object not being to make an index of papers.

It is found that the contributions dealing with lepidoptera probably equal, in number and volume, those relating to all the remaining groups. This, however, is not surprising, for to this order belong the most beautiful examples of all terrestrial life ; flowers of the air, their wings decked with all the hues that blossom or gem can show ; as they wing their brilliant flight through the glad summer days, or hover radiantly over the fragrant blooms, they naturally appeal to every heart which is warmed by the least vestige of artistic or poetic taste. Dull and debased indeed in feeling, and most sincerely to be pitied, must he be who sees not some beauty, feels not something of inward pleasure, in beholding these wonderful atoms of grace and brightness.

> " The dreamy butterflies
> With dazzling colours powdered and soft glooms,
> White, black and crimson stripes, and peacock eyes,
> Or on chance flowers sit,
> With idle effort plundering one by one,
> The nectaries of deepest throated blooms."
>
> —*Robert Bridges.*

Apart also from their beauty of form and richness of ornament in the winged state, the lepidoptera furnish the most interesting and attractive examples for the study of the development and life of the insect, from the egg to the imago. In the larval stage they also play a most important part in the economy of nature, and make man pay tribute in varied and large measure. Yet even in this favorite order there remains plenty of work

for our entomologists, and far from discouraging those who are engaged in such attractive studies, I would urge them to perfect their knowledge by careful observations on the early stages of our lepidopterous friends and foes, so that they may make their light to shine for the guidance of their fellow students.

Next to the butterflies, the beetles have ever been the favorite prey of the budding entomologist. Very numerous, varied in form and habits, yet easy to collect and preserve, they yield themselves most readily to the formation of an attractive and easily cared for collection. The coleoptera have for these reasons been so thoroughly collected in northern countries, that there remains, even in Canada, a very small percentage of species not already known to entomologists. Even microscopic species from most remote localities, with few exceptions, prove to have received a name and character—even if the character may occasionally not be a good one, or sufficient to qualify the beetle for the position in which it has been placed. Yet there remains abundance of work for our coleopterists in the more careful collecting of the smaller species, and the preparation of accurate local lists, and especially in the study of the early stages of our beetles, since the complete life history of comparatively few species is known.

"Among the yellow pumpkin blooms, that lean
Their crumpled rims beneath the heavy heat,
The striped bees in lazy labor glean
From bell to bell with golden-feathered feet."
—*Lampman.*

Of recent years more attention has been directed to the study of the hymenoptera, and interest in these insects has been stimulated by the publication of several fine works. The publication by Cresson of a synopsis of the families and genera, and a catalogue of the described N. A. species has much facilitated the determination and arrangement of collections, but species are being so rapidly discovered and described, that a new edition will soon be necessary to make it conform to the present knowledge of the order. To our younger members, who have not yet settled upon any special line of investigation, I would strongly recommend the consideration of this order, to which my own attention has been chiefly given for several years. The species are very numerous, more so even than the beetles, and the habits of its members are of wonderful variety and interest. From the bees, wasps and ants, with their well developed mental faculties and their highly organized family communities, we pass to microscopical forms of which a score may develop in a single butterfly egg. The study of these insects is most absor ing, and inexhaustible fields of enquiry are open. It would be very encouraging to see more students attracted to this order; taking up special families, and by sustained and serious researches aiding in the elucidation of many perplexing problems.

"Mist of grey gnats that cloud the river shore
Sweet even choruses, that dance and spin
Soft tangles in the sunset."
—*Lampman.*

Apart from the three orders to which reference has been made, there has been but a meagre investigation of our insects, notwithstanding their claims to a due share of attention. The diptera are numerous in species and individuals, of much diversity of habit, and of great influence upon the bodily and temporal welfare of man. The order is difficult to study for the very reason that so few have devoted their attention thereto, but it affords scope for much original work, which cannot fail to be of great importance. There are probably hundreds of species now in the collections of our members waiting for some student to make them known to us.

The neuroptera and pseudoneuroptera are less rich in species, but include some of our largest and most striking insects, such as the dragon-flies.

"To-day I saw the dragon-fly
Come from the wells where he did lie.

An inner impulse rent the veil
Of his old husk; from head to tail
Came out clear plates of sapphire mail.

He dried his wings; like gauze they grew;
Thro' crofts and pastures wet with dew
A living flash of light he flew."
—*Tennyson.*

The early stages of many forms can be advantageously studied in aquaria, for the life histories of but few of the American species have been published. Here is another inviting and almost unoccupied field for students seeking a special line of work.

The same may be said of the orthoptera, our species of which are not numerous, but of moderate size and frequently present in great abundance. They are among the most destructive insect enemies of plant life, but atone, in some measure, for their ravages, by the animation of their movements, and their almost ceaseless stridulation breaking agreeably the silence of the fields.

> "In intervals of dreams I hear
>   The cricket from the droughty ground ;
> The grasshoppers spin into mine ear
>   A small innumerable sound."
>
> —*Lampman.*

The hemiptera consist of two very large and important groups, which contain many species exceedingly injurious to the crops which man raises, with so much labor, for his sustenance, and even from merely material motives the "bugs" are deserving of careful study. Nor are these insects all unattractive in their forms and habits ; many of them, in fact, are very prettily ornamented. It is fully time that some attention was bestowed upon them by our members.

Even yet the avenues of study have not been exhausted ; when all the six-footed insects have been examined there still remain for observation the spiders, skilful weavers of the silken films that glisten in the morning dew ; the mites, so small and yet so grievously afflicting man and beast and plant ; with other allied arthropods of considerable variety of form and habit, which fall within the scope of entomological research.

The volumes of the *Canadian Entomologist* contain many important papers by our numerous and hard working entomological friends in the United States, upon the orders and groups which have been so much neglected by our own correspondents. These papers indicate the interest and value which is attached to their study, and in these contributions it is often observed that the species under discussion have been derived from Canadian sources. This indicates that our collectors are not working up the material that they obtain with so much care and patient searching. It is certainly easier to send specimens to specialists abroad than it is to determine them with the scanty library and cabinet resources at the command of most of us. But one should not rest satisfied merely with such determinations, but by subsequent study of his insects increase his knowledge regarding them. He will thus be able, at least, to publish correct local lists which may be of great value in the more complete study of the fauna of larger regions, and as data for establishing the distribution of species.

There is a great temptation to amass large collections, which in themselves are very desirable and important, but whose care and incident correspondence and exchange may so engross one's time that profitable lines of investigation are neglected, and one becomes merely an insect curator instead of an entomologist. The finest collection may be suddenly destroyed or its possessor incapacitated for further labor, and the knowledge which he has accumulated by many years of patient toil is then lost to science, if it has not been published. There are rare instances of writers who seem unable to restrain themselves from any topic, but the majority of entomologists doubtless find, as I do myself, that it is far more pleasant to collect, examine and arrange their specimens than to sit down and write about them. Yet we should try to do our duty in this respect also, knowing that, if we have made discoveries or valuable observations, we owe it to our fellow-workers to make them participants therein through the pages of the *Canadian Entomologist.*

If gentlemen, you have found my paper dry, I may but hope that it has been dry enough to kindle fresh entomological fires, or add fuel to those already existing ; fires that shall emit not merely flashes of passing enthusiasm but which shall burn brightly and steadily, casting light where the shadows now deepen, and by genial warmth stimulating to renewed attack upon the myriad problems which await your solution in the almost limitless and ever-attractive domain of Insect Life.

Appendix A.—List of Fifty Contributors, with the Number of Volumes to which they Contributed

	No.		No.
Bean, Thos. E., Laggan	2	Hausen, J. F., Montreal	2
Bell, Prof. J. J., Belleville	2	Heustis, Mrs. Caroline E., St. John, N.B.	5
Bell, J. T., "	4	Jack, John G., Chateaugay Basin	5
Bethune, A. M., Port Hope	1	Johnston, James, Hamilton	1
Bethune, Rev. C. J. S., Port Hope	22	Jones, J. Matthew, Halifax	1
Billings B., Ottawa	1	Keen, Rev. J. H., Masset, B.C.	1
Bowles, G. J., Quebec, Montreal	12	Kilman, A. H., Ridgeway	3
Brodie, W., Toronto	5	Lyman, H. H., Montreal	12
Caulfield, F. B., Montreal	14	Macoun, John, Belleville	1
Clementi, Rev. V., North Douro	4	Moffat, J. Alston, Hamilton	16
Couper, W., Montreal	9	Murray, Wm., "	3
Cowdry, N. H., Stratford	1	Norman, Geo., St. Catharines	2
Croft, Prof. H., Toronto	2	Pearson, C. W., Montreal	3
Danby, W. H., Victoria	2	Pettit, J., Grimsby	5
Dawson, Percy M., Montreal	1	Provancher, Abbe, Cap Rouge	2
Denton, J. M., London	1	Reed, E. Baynes, London	13
Evans, J. D., Trenton	1	Rogers, R. V., Kingston	5
Fletcher, J., Ottawa	13	Saunders, H. S., London	1
Fyles, T. W., S. Quebec	12	" Prof. W., "	19
Geddes, Gamble, Toronto	7	" W. E., "	2
Gibb, Lachlan, Montreal	1	Taylor, Rev. G. W., Victoria	4
Gott, B., Arkona	1	White J., Edmonton, Ont	1
Guignard, J. A., Ottawa	2	Williams, J., London	1
Hanham, A. W., Hamilton	2	Winn, A. F., Montreal	2
Harrington, W. H., Ottawa	14	Wintle, Ernest D., Montreal	1

Appendix B.—List of Contributions (not Complete) by the Writers Mentioned in Appendix A

Lepidoptera.

	Vol.
Entomological Notes (a series of papers), Saunders	I.
Notes on Canadian Lepidoptera (a series of papers), Bethune	I.
List of Diurnal Lepidoptera observed in the neighborhood of Ottawa, during the season of 1868, Billings	I.
Larva infesting the Parsnip (*Depressaria Ontariella* n. sp.), Bethune	II.
On a supposed new Arctian, Saunders	II.
Description of larva of Catocala Polygama, Guen., Reed	II.
Notes on Hadena Xylinoides, Saunders	II.
On the larva of Thecla inorata, G. R. Saunders	II.
A new species of Anarta, Bethune	II.
Note on Amphipyra Tragoponis, Bethune	II.
On the larvæ of some Lepidoptera, Saunders	II.
List of Lepidoptera taken at Quebec, Bowles	II.
Accentuated list of Canadian Lepidoptera, Reed	II.
On Neonympha Eurythris, Fab., Saunders	II.
Notes on Lepidopterous Larvæ (series of papers) Saunders	III.
Notes on Samia Columbia, Bowles	III.
Lepidoptera of Anticosti and North Shore of the St. Lawrence, Couper	IV.
Captures of Noctuidæ at St. Catharines, Ont., Norman	VII.
List of Diurnal Lepidoptera of the Island of Montreal, Caulfield	VII.

Coleoptera.

Hymenoptera.

Diptera, Hemiptera, Neuroptera and Orthoptera.

General Papers.

A vote of thanks to Mr. Harrington for his valuable and very interesting address was moved by the Rev. Dr. Bethune, who remarked in doing so that he hoped all the members of the Society would be stimulated by the historical record their President had given them to fresh efforts in their investigations and renewed zeal in contributing their observations to the *Canadian Entomologist* and the Annual Report. Mr. Fletcher, in

seconding the motion, gave an account of the admirable work that Mr. Harrington has been doing for many years past in collecting and studying the coleoptera and hymenoptera of Ottawa and its neighborhood ; in the latter order especially he had accomplished very much, and described a number of new species. The motion was very cordially received by the meeting, and the vote of thanks was accorded with much acclamation.

The reports of the different sections of the Society were then presented and read by their respective Secretaries

The Treasurer, J. A. Balkwill, read the following report of Receipts and Expenditure for the year ending August 31st, 1894 :

Report of the Treasurer.

Receipts, 1893-4.		Expenditure, 1893-4.	
Balance on hand Sept. 1st, 1893	$ 457 54	Printing	$ 631 33
Members' fees	291 08	Report and meeting expenses	157 70
Sales of Entomologist	73 90	Library	82 05
" pins, cork, etc.	62 79	Expense, postage, etc.	116 82
" duplicates	5 25	Rent and fuel	159 97
Government grant	1,000 00	Insurance	28 00
Advertisements	13 50	Salaries	350 00
Interest	14 24	Pins, cork, etc	31 83
		Balance on hand Aug. 31st, 1894	360 60
Total	$1,918 30	Total	$1,918 30

We, the Auditors of the Entomological Society of Ontario, certify that we have examined the books of the Treasurer, compared them with vouchers, and find them correct, and that the above is a true statement.

John M. Denton, } Auditors.
Jas. H. Bowman, }

REPORT OF THE MONTREAL BRANCH

Mr. H. H. Lyman read the following report .

Annual Meeting of the Montreal Branch of the Entomological Society of Ontario :

The 21st annual meeting of the Montreal Branch was held at the residence of Mr. H. H. Lyman, 74 McTavish street, on Tuesday evening, May 8th, at 8 o'clock.

Members present, Messrs. H. H. Lyman, President ; J. F. Hausen, W. C. Adams, A. F. Winn. Rev. E. C. Trenholme, a former member was also present.

The President presented the following report of the Council :

21st Annual Report.

The Council beg to present the following report for the year 1893-94 :

From a variety of causes we have had less meetings than usual during the past winter, but the four that were held were well attended, and the following papers have been read :

I.—Common names for butterflies. Shall we have them ? H. H. Lyman.

II.—A Trip to Gomin Swamp, Quebec. H. H. Lyman.

III.—Trypeta solidaginis and its parasites. Rev. T. W. Fyles.

One new member has been added to our roll, Mr. O. C. Hart, but the resignation of Mr. H. B. Cushing has lost us one.

The Council would urge the members to contribute more papers at the meetings, giving accounts of some of their collecting trips, or experience in raising species from the egg or larva as well as to bring more specimens with them.

The present season has opened unusually early, and there seems to be a prospect of a particularly good year for insects, and it is hoped that a lot of good work will be done by our entomologists.

The Treasurer's report showed the balance at our credit to be growing slowly.

Respectfully submitted on behalf of the Council.

(Signed), H. H. LYMAN,
President.

The following officers were elected for the ensuing year :

President—H. H. LYMAN.

Vice-President—LACHLAN GIBB.

Secretary-Treasurer—W. C. ADAM.

Council—J. F. HAUSEN, A. F. WINN.

Mr. Winn read a paper entitled "An Hour at Hochelaga," illustrated by the specimens taken.

The meeting then adjourned.

A. F. WINN,
Secretary.

REPORT OF THE GEOLOGICAL SECTION.

Mr. President and Members :

I regret that the chairman of our section for the past year is not with us to-night. I refer to the Rev. Chas. Andras, who, you will remember, was with us a year ago at our last annual meeting, but has now gone to reside in the North West. We expected with his assistance to have presented a full and comprehensive report of the proceedings of our Society for the past season. We have had no more active member in our section than he since its organization. All his spare moments were devoted to making a collection of the minerals and fossils of this region, most of which were exhibited to the class from time to time, adding very much to the interest as well as profit, and giving us some idea of what might be obtained at our own doors. He made a very large private collection during the time he was with us. Together we visited most of the outlying towns in search of specimens for our cabinets, and have travelled on foot many a mile in these holiday outings.

Among other places we have visited St. Marys, Dorchester, Kilworth, Byron, Komoka, Kettle Point (Lake Huron), Ilderton, Thedford, Beachville and Woodstock.

Occasionally we had some of our fellow workers to bear us company and assist in our undertakings and researches.

I can only mention a few of my observations along the geological line. The work undertaken by this section has been greater and more successful than in any previous year, not only as regards the material that has been collected, but also in the interest the members have shown by regular attendance at our weekly meetings, and taking an active part in the discussions that have arisen from the objects laid before them.

We have also been favored with several interesting lectures and papers on various geological subjects as follows :

By the Rev. Prof. Andras :

I.—Earthquakes.

II.—Talk on British Coal Fields.

III.—Sketches of his North West Travels.

By Prof. J. H. Andras :

I.—Papers on Cephalapoda.

II.— " " Arcidae.

By Dr. I. G. Wilson :

I.—Paper on Silica.

II.— " " Glacial Drift.

By Mr. I. Goodburn :

I.—Lecture on the Six Days' Work of Creation.

By. S. Woolverton :

I.—Paper on Trilobites.

It is proposed to print some of them for circulation, or if thought worthy in the Journal of this society. Several of these addresses were given at the home of the vice-chairman, where an available collection is to be found, the better to illustrate the subject of the lecture.

Another observation perhaps worthy of mention, is the finding of a great number of Indian relics in this vicinity during the past summer. A number of mounds have been dug over and many rare specimens have been obtained of the North American Indian, notably—skinning-stones, pipes, bone needles, bones of the animals eaten by early inhabitants, in a perfect state of preservation, with pottery in great abundance.

The remains were all found in ash heaps, kitchen middens so called, showing conclusively that this was once a favorite resort and hunting ground of a race of people that have faded away over three hundred years ago.

From this source sufficient material has already been collected to stock a department in a public museum.

S. Woolverton,
Vice-Chairman.

REPORT OF THE BOTANICAL SECTION OF THE ENTOMOLOGICAL SOCIETY.

The Botanical Section beg to offer the following report for the summer of 1894.

The first meeting was held on April 21st, and from that date until September 24th regular meetings were held, except for a part of August.

At all the meetings the attendance has been fair, and a number of young business and professional men have become enthusiastic workers. The principal work undertaken was the collection, identification and recording of the phaenogamous plants of this district.

Field days in various directions were very fruitful, especially to Komoka on May 24th, when 77 species of plants were identified, all in bloom. At Mud Lake, south of Dorchester station, the beautiful and extremely sweet scented *Habenaria blephariglottis* was found abundant on July 2nd.

Probably the most important collections of the season were : *Collinsia verna*, taken by Mr. Robert Elliott near Plover Mills, London township, Middlesex, May 26th, now first recorded in Canada ; and *Utricularia resupinata*, collected by Mr. J. H. Bowman, near Bala, Muskoka, not before identified and recorded to our knowledge.

A specimen of the notorious Russian Thistle was found by Mr. Dearness, near Tilbury Centre in Kent county.

All of which is respectfully submitted.

W. F. McClement,
Secretary.

REPORT FROM THE ENTOMOLOGICAL SOCIETY TO THE ROYAL SOCIETY OF CANADA.

By Rev. Thomas W. Fyles, F. L. S., Delegate.

I have the honor to report that the Entomological Society of Ontario continues, with zeal and success, its researches into all such subjects as naturally fall under, or in any way have a bearing upon Scientific and Economic Entomology.

The membership of the Society during the past year has greatly increased, especially by additions from the Province of Ontario. This fact betokens both a growing interest in the subject of entomology, and also an increasing confidence in the Society as a guide and helper in its pursuit.

The Society was established in 1863. Of its founders but few now remain; most of them have been lost to us through death, or departure to distant places of residence. By the members of the present day their memory is held in grateful respect. The Society, however, still enjoys the benefit of the experience and scholarship of the Rev. C. J. S. Bethune, and the business talent of Mr. J. M. Denton. The names of these gentlemen appeared in the first list of officers published by the Society, and they are found also in the list published for the present year.

The Society enjoys the confidence of the many able entomologists who have been appointed to positions in the colleges and experimental stations of the United States of America; and numerous articles from these gentlemen have appeared in the Society's publications. It also numbers among its correspondents leading entomologists in England and Germany.

It is largely due to the wise and liberal support of the Ontario Government that the Society has been enabled to attain its present eminent position of usefulness.

The report of Mr. J. A. Balkwill, Treasurer of the Society, shows that its finances are in a highly satisfactory state—all expenses having been met, important purchases for increasing the advantages of the Society having been made, and a sufficient balance remaining for carrying on the immediate work of the Society.

Seventy volumes have been added to the Society's library in the course of the year, by donation and purchase. Among them are: the "Tenth Volume of the Proceedings and Transactions of the Royal Society of Canada," "The Report of the Ontario Game and Fish Commission," "The Report of the Smithsonian Institution," "The Report of the New York State Museum," "The Mammals of Minnesota," "The Hawks and Owls of the United States," "The Seventeenth Report of the Geology and Natural History of Indiana." The number of books in the library is now 1,284. Very important additions have also been made to the Society's collections of natural objects.

Valuable work has been done by the Ornithological, the Botanical, the Microscopical and the Geological Sections of the Society, and a report from each of them was read at the annual meeting. With a view to bringing the knowledge and experience of the members of these sections to bear more frequently for the good of the Society at large, a Committee on Field Days, consisting of Dr. Woolverton, Messrs. McClement, Elliott and Stevenson, and one representative from each section, was appointed at the annual meeting.

The Montreal Branch of the Society held eight meetings during the year, at which interesting papers were read, and much profitable conversation upon entomological subjects generally was held. The branch numbers among its members men well acquainted with the entomology of the Montreal Island: Messrs. L. Gibb, A. F. Winn, F. Hausen and H. B. Cushing; and the hospitality of Mr. H. H. Lyman, the president of the branch, and the access he has afforded to his extensive collections of lepidoptera have made the meetings of the branch exceedingly pleasant and profitable.

The Annual Report of the Society, printed by order of the Legislative Assembly of Ontario, contains: a record of the proceedings of the annual meeting held October 11th

and 12th; reports from the council and the various officers and sections of the Society; the opening address of Mr. James Fletcher (given in the absence of the president), and telling of the injurious insects of the year and the various modes of dealing with them: and the annual address of the president, Mr. W. Hague Harrington, likewise containing much valuable information on these subjects. These are followed by contributions from members of the Society, viz.:

"The Entomological Mistakes of Authors," by Rev. Thomas W. Fyles, South Quebec.

"The Season of 1893," by the same.

"Mosquitoes," by J. Alston Moffatt, London, Ont.

"Canadian Uroceridæ," by W. Hague Harrington, Ottawa.

"Additional Notes on Japanese Insects," by the same.

"Notes and Queries," by Rev. W. J. Holland, Ph.D., Allegheny, Pa.

"The Dragon Fly," by T. J. MacLaughlin, Ottawa.

"The Song of Thyreonotus," by William T. Davis, Staten Island, N.Y.

"Notes on some of the more important Entomological Exhibits at the Chicago Exhibition," by James Fletcher, Ottawa.

Then comes a full report of the annual meeting of the Association of Economic Entomologists, furnished by Mr. L. O. Howard, of the Division of Entomology, Department of Agriculture, Washington, D.C., together with some of the most generally interesting papers read at the meeting. Some of these are by the most eminent and practical entomologists of the United States, and all of them are valuable. The closing pages of the report are devoted to book notices, obituaries, etc.

The *Canadian Entomologist*, the Society's monthly organ, completed at the end of the year its 25th volume. This volume contains descriptions of no less than 162 new species of insects. The contributors to its pages number 56. Among them are men of world-wide reputation.

That the Society may be of service to the community at large, by teaching our farmers, gardeners and fruit growers the life histories of their insect friends and insect foes, and by showing them how the injurious attacks of the latter are carried on, and what steps should be taken to meet and nullify them is, we believe, the earnest desire of every one of its numerous members.

Appended will be found a list of the officers of the Society.

The whole is respectfully submitted.

THOMAS W. FYLES, F.L.S., Delegate.

ELECTION OF OFFICERS.

The following gentlemen were elected officers for the ensuing year:

President—W. HAGUE HARRINGTON, F.R.S.C., Ottawa.

Vice-President—J. DEARNESS, London.

Secretary—W. E. SAUNDERS, London.

Treasurer—J. A. BALKWILL, London.

Directors—Division 1, JAMES FLETCHER, F.L.S., F.R.S.C., Ottawa.
Division 2, REV. C. J. S. BETHUNE, F.R.S.C., Port Hope.
Division 3, GAMBLE GEDDES, Toronto.
Division 4, A. H. KILMAN, Ridgeway.
Division 5, R. W. RENNIE, London.

Librarian and Curator—J. ALSTON MOFFAT, London.

Editor of the "Canadian Entomologist"—REV. C. J. S. BETHUNE, M.A., D.C.L., Port Hope.

Editing Committee—J. FLETCHER, Ottawa ; H. H. LYMAN, Montreal ; REV. T. W. FYLES, South Quebec ; J. M. DENTON and J. H. BOWMAN, London.

Delegate to the Royal Society—REV. T. W. FYLES, South Quebec.

Committee on Field Days—DR. WOOLVERTON, Messrs. McCLEMENT, ELLIOTT and STEVENSON, London.

Auditors—J. H. BOWMAN and J. M. DENTON, London.

Dr. Woolverton exhibited a very perfect and beautiful trilobite, *Phacops bufo*, from the Devonian rocks in the neighborhood, and made some interesting remarks upon the geology of the district.

Mr. Bowman made a verbal report upon the proceedings of the Microscopical Section during the past season.

Mr. W. Scarrow suggested that the Council should be instructed to find more suitable quarters for the Society, as the present room was entirely inadequate for the purpose. The matter was discussed at some length by several of the members, and it was finally decided that the officers of the Society resident in London should be empowered to look for satisfactory accommodation, and take whatever steps might be necessary to secure it.

A very entertaining and interesting paper was then read by the Rev. T. W. Fyles on "Food, Feeders and Fed," which was highly appreciated by the audience.

The meeting adjourned at 10.30 p.m.

THURSDAY, NOVEMBER 8TH.

MORNING SESSION.

The meeting was called to order by the President at 10 o'clock a.m.

The first paper read was by Mr. H. A. Stevenson describing an attack by the moth, *Ephestia interpunctella*, in a warehouse in London, and the successful manner in which it had been dealt with.

Dr. Bethune then read an interesting paper on "The Economic Value of Parasitism," by Prof. F. M. Webster, of Wooster, Ohio. Mr. Harrington, in commenting on the paper, stated that the canker worms which had been so injuriously abundant about Ottawa for two or three years, were this season almost exterminated by their parasites.

Mr. Moffat presented papers on "A re-appearance of Pieris Protodice," and "Remarks on the Structure of the Undeveloped Wings of the Saturniadæ."

A paper by Prof. L. R. Jones, of the Agricultural Experiment Station at Burlington, Vermont, on "Bordeaux Mixture as a Deterrent Against Flea-beetles," was presented by Mr. Fletcher.

[All the papers read at the different sessions are printed *in extenso* in the following pages of this Report.]

Resolutions regarding the binding of periodicals and the case of members in arrears with their subscriptions, were brought forward and discussed, and action taken upon them.

The remainder of the morning was spent in examining and determining specimens which had been brought to the meeting by various members. At twelve o'clock the proceedings were brought to a close, all who had taken part in them having much enjoyed their annual gathering and the many interesting papers brought before them.

INSECTS COLLECTED IN BERMUDA DURING THE WINTER OF 1894.

BY GAMBLE GEDDES, TORONTO.

The paper I propose to read before the members of the Society, will not, I fear, treat especially upon insects, for I have experienced great difficulty in securing the names of many of the species captured by me in Bermuda during the four months of last winter beginning in January. I can, however, place a number of examples before you for inspection, which may prove interesting in that they correspond so closely to many of our Canadian insects.

I shall, in the course of the paper, touch upon a few of the food-plants which came under my notice and read a list of the insects named in the only book that I could find on the subject in the Public Library. This list will not, I can assure you, occupy much of your time, as it was published thirty years ago, and very little collecting has been done since.

In considering the diurnal lepidoptera of the Islands, I shall begin first with *Danais Archippus*, which species was flying about freely in February and March. I fancy it must be an all-the-year-round insect as I took eggs and larvæ upon a lovely asclepias (*A. Curassavica*) at the same time that I captured apparently perfect imagos.

Of this asclepias I have raised from seed several healthy plants, and was in hopes that I could produce one in bloom.

Mr Oswald A. Reade, (now a pharmaceutical chemist in London, England), has made his mark as a botanist in Bermuda and elsewhere, and has written a book entitled. "Plants of Bermuda, or Somer's Islands."

In his description of this asclepias (or Butterfly weed) he states that it is a perennial plant, growing from two to four feet high, half shrubby at the base, the stems being cylindrical and downy. The pods are ovate, smooth and seeds embedded in glossy, silky hairs. Distribution, West Indies. Habitat, waste places. He also says flowers showy, scarlet and orange, frequent, July to November.

I presume when he states those particular months he means that these plants are in their "prime" at this time of the year, for I found full grown larvæ, and also, very diminutive larvæ, also eggs, upon asclepias during the months of February and March.

I did not find any of the larvæ on the other asclepias, viz., *A. Linaria*.

The commonest and only other diurnal I captured was *Junonia Cœnia*, and the larvæ of this insect fed freely upon the leaves of the common sage bush. (*Lantana Odorata.*) This shrub forms the principal undergrowth of all the Islands from one end to the other of the group. It has been grown to great perfection in many of our hothouses.

J. Cœnia in its flight reminds me very much of the Vanessidæ and is quite difficult to catch on a sunny day, but easy to net in damp and foggy weather.

These two species are the only ones taken in winter, but a list was printed in "The Naturalist in Bermuda," by Jno. Matthew Jones and Major Wedderburn, (late 42nd Highlanders) and J. L. Hurdis, Esq., in 1863—thirty-one years ago—which reads as follows :

Danais Archippus	Food plant, asclepias, common.
do. Berenice	do. rare.
Vanessa Atalanta	April to November.
Cynthia Cardui	Early November, abundant 1852.
Vanessa Antiopa	Rare.
Junonia Cœnia	Called Musk Butterfly, common.
Terias Lisa	September, October and November.
Unknown (1853, September)	Brimstone yellow, tinged with a greenish hue large as English Brimstone Butterfly, taken on potato patches.

These eight varieties of butterflies appear to be all known at that time whilst none of the Skippers or Lycænidæ appear to have been captured. This seems a curious fact as it is well known that both families are abundantly represented in the southern States and in all the West Indian Islands.

Sphinx (*Phlegethontius*) *Cingulata* is very common in season, the larva is taken on the Papaw (*Asiminia Triloba*) has a thick caudal horn and pupates in the ground as most of the Sphingidæ do. (See Grote's check list of the Hawk moths of North America.)

The other Sphinx taken by myself was *Chærocampa* (*Deilonche*, Grote) *Tersa.* Larva feeds on Button-weed (*Spermacoce Glabra.*) Mr. Grote, in his remarks upon this insect says, rare in Canada and Eastern States, more common in the south ; it has at least two congeners : *Deilonche Robinsonii* (Grote) in Cuba, and *D. Falco* (Walker) in Mexico ; comparative studies must be made with other forms referred by Butler to Chærocampa, a genus with European types.

I was also informed in Bermuda that *D. Lineata* had been taken, but I saw no traces of it in the few collections I came across, nor did I take a specimen myself.

I now come to the most interesting part of the collection I made, viz.: the various families of moths outside of the Sphingidæ. I am indebted to Mr. Moffat for his kindness in naming a few that are identical with the Canadian species. I was unfortunate in not meeting Mr. Neumogen, of New York, on my way back, as in these matters he has always been most willing to assist me.

I am not aware of seeing any specimens in the following families, viz.: Ægeriadæ, Thyridæ Zygænidæ, Bombycidæ; but of Noctuidæ, Geometridæ, Pyralidæ and Tortricidæ there is evidently a large field open for collectors even in the winter months. In the Noctuidae the Drasterias and Plusias largely predominate and the undetermined species which I have with me will clearly indicate what a wealth of them exists on these islands.

I shall endeavor to get a correct list of all the Noctuids, as well as the other groups, and give a list of those which have occurred in Canada, that are identical with the Bermudian insects. This list I should be pleased to have published in the " Entomologist " for future reference by those who may be interested.

In Pyralidæ I have taken in numbers, *Eudioptis hyalinata* of Linneus, *Nomophila noctuella*, *Botis adipaloides* and many others not yet identified.

The majority of these moths have been taken in the bright sunshine, mostly during the time of day known in Bermuda as " between the showers " and rarely at dusk.

The favorite flower of the Plusias was *Sinapis nigra* in appearance like a white mustard flower ; also a species of Golden Rod, (*Solidago sempervirens.*)

I have also taken a number of Pyralidæ on the common "Sowthistle," (*Sonchus Oloraceus*) and a few Coleoptera on the same plant.

A few of the micros appeared to gather their food from a beautiful little plant resembling a dicentra, viz.: *Fumaria Deusiflora* ; and *Parthenium Hysterophorus*, a bunch aster, was full of all kinds of insects.

Upon the vetch (*Vicia Saliva* I think) I took numerous Hymenoptera, notably the Bermuda wasp, *Polistes pallipes.*

Upon the flower of the orange Lantana, (*L. Crocea,*) most of the Diptera were caught, and this lovely shrub grows everywhere, so freely that one was seldom at a loss to look for a bush of it.

Coleoptera. Very few Coleoptera are known in Bermuda, as far as I can ascertain, my total catch for over three months being 15 specimens—6 of which evidently are one species taken from the centre of full-blown roses.

Of Diptera I took about 50 specimens, including our own pet housefly. This was by no means uncommon during winter as the domestics had to drive them out of the rooms two or three times a day in fine weather and keep the house quite dark. Another favorite, (the musquito,) was only too common, and for variety in size and the nature of

its bite, I consider them unequalled. These unwelcome intruders kept me so continually busy in looking after my own interests that I came to the conclusion I would not study their food plants—nor would I recommend them to any of my Bermudian friends as a "benefical insect" (to mankind at least.)

Of Hemiptera about 6 varieties were captured, principally about the Loquat tree and upon the tree known as The Pride of India.

The Loquat is a favorite fruit with not only the natives but nearly every visitor who tastes it. The botanical name is *Cydonia Japonica*, and as its name implies is a native of Japan, and thrives in sheltered places.

The Pride of India, (*Melia Azedarach*) is a grand tree and lines the boulevards of the principal streets in Hamilton. I have water-color sketches of these trees, one in fruit the other in flower.

There is one other fruit tree the product of which seems most palatable to the natives, viz.: The Surinam Cherry. I am at fault about the scientific name, but also produce a water-color sketch of the fruit at its best. Upon the blossoms the Plusiadæ and bees are to be taken, frequently in February and March. I have no doubt in the summer months the second crop would attract many more examples, for the trees fruit twice a year, I have been told by old residents.

Referring to this tree I have taken a few katydids and grasshoppers. (Orthoptera,) amongst them doubtless *Conocephalus Ensiger*, although I must confess I prefer the song of his green colored cousin *Phylloptera Oblongifolia*, hailing from our midst and which is found drowned so often on the shores of our lakes in Upper Canada after a heavy gale of wind.

The spiders would give entertainment to any enthusiast for months, for their name is legion.

In conclusion I may add that the Neuroptera were very scarce during the wintertime, although I saw several varieties in some of the local collections which were unnamed. Evidently they were abundant about the marshes during the summer months.

COMMON NAMES FOR BUTTERFLIES.—SHALL WE HAVE THEM?

By H. H. Lyman, Montreal.

Read before the Montreal Branch 14th November, 1893.

This is a question upon which the entomologists of this continent have been as much divided as upon any of the deeper scientific problems which have engaged their attention.

The great majority of the working entomologists have been strongly opposed to their introduction, some even fiercely so, but there have been a few entomologists, some of them of the first rank, who have espoused their cause with at least some measure of success.

Of course there are many objections to these names, the chief being their purely arbitrary and unscientific application, the impossibility of securing uniformity in their use and the difficulty of obtaining suitable and sufficiently concise names for more than a very limited fauna

The opponents of popular names assert that it should be as easy to remember the scientific as the common names and that if it is not, we should not encourage laziness by adopting them.

I used to be as strongly opposed to these names as anyone, but latterly have sometimes thought that if their adoption would result in popularizing the study of this science the gain would be worth the sacrifice.

In this paper, therefore, I propose to discuss this subject which has recently been brought again into view by Mrs. Slosson's interesting paper in the first number of the journal of the New York Entomological Society, and shall try to do so in a calm and judicial manner. Of course Mrs. Slosson would not suggest that the names which commend themselves to her proteges should be generally adopted, but why should we not have common names scientifically applied?

It is all very well to say that it should be as easy to remember the scientific as the popular name, but it isn't. It ought to be, of course, just as it ought to be just as easy for children to be good as to be naughty.

I have often been asked the name of a moth and when I had given it, it has been greeted with a laugh of derision, for the general public scoff at these scientific names, and one doesn't wonder when one looks over a catalogue and sees the terrible names, such as nezahualcoyotl, which have been given to beautiful and inoffensive creatures.

It does not degrade Botany to have the Cypripedium called the Lady's Slipper, the Ranunculus the Buttercup, or Lonicera the Honeysuckle, nor does Ornithology suffer because Hirundo Horreorum is better known as the Barn Swallow, and Tyrannus Carolinensis as the Kingbird, and why should there be an outcry at calling the lovely Idalia the Regal Fritillary, or Grapta Gracilis the Hoary Comma?

I believe that if we could have common names for our butterflies and a cheap, but good, book with a recognizable colored illustration of each species, such as England has in Coleman's British Butterflies, we should have at least ten persons interested in entomology for every one that we have to day.

If it be urged that it is impossible to secure absolute uniformity in the use of these names the same is true of the scientific names, as we all have to remember in reading Mr. Scudder's works that what he calls Jasoniades Glaucus is what the rest of us call Papilio Turnus.

It seems to me that one of the chief objections to the adoption of these popular names is their arbitrary application totally regardless of scientific relationship. For instance, they have in England two butterflies, known respectively as the White Admiral and the Red Admiral. Naturally one would suppose that these belonged to the same genus, instead of which they belong to entirely distinct genera, which in Kirby's world-wide catalogue are separated by fifty-seven other genera, while on the other hand the nearest ally in England of the Red Admiral is called the Painted Lady, which is surely an opprobrious name.

When I began collecting as a child, upwards of thirty years ago, and wanted to know the names of my treasures, I was told that Cardui was the Thistle butterfly. Shortly afterwards I captured a specimen of Atalanta, and fairly gloating over the pre-eminent beauty of its under surface I named it the Queen Thistle, for child though I was, I at once recognized its close relationship to the other. But in the common names which have been proposed by various authors, the generic relationship has frequently been lost sight of. A very marked example of this occurs among Scudder's names in two cases adopted from Gosse, for some of the Pierinæ; thus Eubule is the Cloudless Sulphur; Philodice is the Clouded Sulphur; Lisa is the Little Sulphur. Then in the genus Argynnis, Atlantis is the Mountain Silver Spot while Aphrodite is the Silver Spot Fritillary, the latter certainly a most indefinite name considering the number of silver spot fritillaries we have on this continent. On the other hand some of Gosse's names were so well chosen that we can recognize the species intended even when linked to wrong scientific names. This is strikingly the case in the Graptas, for which his names were particularly appropriate and have in all but one case been adopted by Scudder.

The Violet Tip was his name for Interrogationis; the Green Comma, though doubtfully linked with the name Progne, must have been intended for Faunus, not at that time described, while the Orange Comma and the Gray Comma well indicate G. Comma and G. Progne. It is doubtless true that in English works the popular name is frequently given undue prominence, being printed in large type at the beginning of a description,

while the scientific name is given in italics, or in brackets at the end of the description, and the same prominence was, I found, given to popular names in the beautiful economic exhibit from the Entomological Division of the Department of Agriculture in the U. S. Government building at the World's Fair; but it is not necessary to follow this custom, and we could very well print the scientific name first in large type and the popular name second in smaller type as is done by Mr. Scudder in his "Butterflies of New England."

But if it be agreed that the adoption of popular names is on the whole desirable, is it practicable? No doubt it is for a limited fauna like that of England or New England, but is it for the whole of North America?

Who will undertake to invent suitable popular names for the upwards of sixty species of Argynnis, the nearly forty species of Melitaea, the fifty species of Thecla, the equal number of species of Lycaena, or the upwards of ninety species now grouped under the generic name Pamphila?

I confess the idea appears to me utterly hopeless and impracticable.

THE BUTTERFLIES OF THE EASTERN PROVINCES OF CANADA.

BY REV. C. J. S. BETHUNE, PORT HOPE, ONTARIO.

The following list of the butterflies of the Eastern Provinces of Canada has been prepared in order to bring together in convenient form all the localities that have been published as well as those that have come under my own observation. The list is as complete as I can at present make it, but no doubt there are many collectors in different parts of the country who could add largely to the localities given, and possibly add a few more species to those here recorded. The time of flight and the food-plants are given in most instances.

The question of nomenclature and arrangement has been a difficult one to decide. It will be observed that I have followed the order of families and genera given in Dr. J. B. Smith's "List of Lepidoptera of Boreal America," (Philadelphia, 1891), and have for the most part adopted the nomenclature of Mr. W. H. Edwards's "Revised Catalogue of the Diurnal Lepidoptera of America North of Mexico," (Philadelphia, 1884). For the sake of convenience I have added in brackets Mr. Scudder's name for the species whenever it differs from that which I have employed. I have also followed Mr. Edwards in beginning the specific names with a capital letter as they are nearly all proper names and seldom adjectives.

In the preparation of this list the records of the following authors and observers have been gone over for localities in the Province of Ontario: Messrs. D. W. Beadle, St. Catharines; J. M. Denton, London; J. D. Evans, Sudbury; G. Geddes, Toronto; Rev. W. Kirby, ("Fauna Boreali-Americana: Insecta"); Theodore L. Mead, Oviedo, Florida; Prof. J. Macoun, Geological Survey of Canada, Ottawa; J. Alston Moffat, London; J. Pettit, Grimsby; E. Baynes Reed, London. For both the provinces of Ontario and Quebec: Messrs. B. Billings, Ottawa; W. H. Edwards ("Butterflies of North America, etc.); J. Fletcher, Ottawa; Prof. W. Saunders, Ottawa; S. H. Scudder ("Butterflies of the New England States and Canada"). For the Province of Quebec alone: Dr. R. Bell, Geological Survey of Canada, Ottawa; J. G. Bowles, Montreal; F. B. Caulfield, Montreal; W. Couper, Montreal; W. S. M. D'Urban, Montreal; Rev. T. W. Fyles, South Quebec; P. H. Gosse, Compton, ("Canadian Naturalist"); J. G. Jack, Chateauguay Basin; H. H. Lyman, Montreal; A. F. Winn, Montreal. For Nova Scotia and New Brunswick: Mrs Heustis, St. John; J. Matthew Jones, Halifax. For Newfoundland: Capt. Brown and Mr. P. H. Gosse. For Labrador and Hudson Strait: W. Couper and Lieut. Payne. For Prince Edward Island: Prof. John Macoun,

LEPIDOPTERA.

Rhopalocera.

Family Nymphalidæ.

Sub-family *Euploeinæ*.

1. Danais Archippus, *Fabr.* (*Anosia plexippus*). Abundant throughout Southern and Eastern Ontario; taken also on the shores of Georgian bay, at Sault Ste. Marie and Nepigon; rare in the Province of Quebec, taken at Montreal, Sorel, Quebec, River Rouge district, Little Metis; rare in Nova Scotia. Earliest dates, May 24, June 4, 6, 7, 12, 14; very common in July; especially abundant in August and September; latest dates, October 23, 27. Food plant, Asclepias. Fig. 1, represents the butterfly; Fig. 2, the caterpillar; Fig. 3, the successive changes to chrysalis; Fig. 4, the chrysalis.

Fig. 1.

Fig. 2.

Fig. 3.

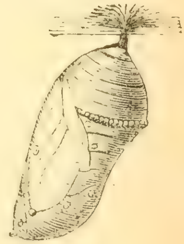

Fig. 4.

Sub-family *Nymphalinæ*.

2. Euptoieta Claudia, *Cram.* Very rare. Has been taken at Wabigoon, Ont. (J. C. Guillim), London, St. Catharines, Chateauguay Basin, Montreal (Aug. 15, 1874); also in Manitoba and North-West Territories. Food plants—Violet, Passion Flower, Sedum, Portulaca, Desmodium, Podophyllum.

3. ARGYNNIS CYBELE, *Fabr.* Common throughout Ontario and Quebec. Taken at Nepigon, Sault Ste. Marie, Georgian bay, Cameron lake, Amherstburg, Point Pelee, London, West Flamboro', Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa; Montreal, Eastern Townships, Quebec, Little Metis; also in Cape Breton and Prince Edward Island. Flies during July, August and September. Food plant of this and the other species of Argynnis is the various species of Violets.

4. ARGYNNIS APHRODITE, *Fabr.* Taken throughout Ontario and Quebec. Nepigon, Sault Ste. Marie, north of Lake Huron, Sudbury, Cameron lake, London, Hamilton, West Flamboro', Credit, Toronto, Cobourg, Ottawa; Montreal, Sorel, Quebec, Lower St. Lawrence and Bay of Chaleur; Restigouche river, New Brunswick; Nova Scotia; Prince Edward Island; Moose Factory, James's bay. Flies during July and August.

5. ARGYNNIS ATLANTIS, *Edw.* Common throughout Northern Ontario and Eastern Quebec. Moose Factory, Nepigon, Fort William, Sault Ste. Marie, Ottawa (rare); Montreal (very rare), Co. Missisquoi, P. Q., Little Metis, Godbout river, Cacouna, Lower St. Lawrence; Anticosti, Labrador, New Brunswick, Nova Scotia, Cape Breton, Newfoundland, Prince Edward Island. Flies during July and August.

6. ARGYNNIS ELECTA, *Edw.* Nepigon (Macoun, Fletcher, Bethune).

7. ARGYNNIS CIPRIS, *Edw.* Nepigon (Bethune and Fletcher). Sudbury (Fletcher and Evans), August.

8. ARGYNNIS MYRINA, *Cram.* (*Brenthis Myrina*). Common throughout the eastern Provinces of Canada. Nepigon, Fort William, Sault Ste. Marie, Sudbury, London, Hamilton, St. Catharines, Grimsby, Credit, Toronto, Cobourg, Rice lake, Ottawa; Montreal, River Rouge district, Eastern Townships, Quebec, Cacouna, Little Metis, Godbout river, Lower St. Lawrence; Metapedia river, Dalhousie, N.B., Nova Scotia, Cape Breton, Prince Edward Island. Flies during June, July and August. Taken at Montreal in May and at Ottawa in September.

9. ARGYNNIS CHARICLEA, *Ochs.* (*Brenthis Chariclea*). Port Arthur, Spanish river, Nepigon, Georgian bay (Lyman), July. Labrador, May 30 and June (Couper). Mingan, July 22. Hudson bay.

10. ARGYNNIS FREIJA, *Thunb.* (*Brenthis Freija*). Port Arthur, Fort William; Quebec, Gomin Swamp; Labrador, Hudson's straits, Cumberland House, Lat. 54° (Kirby), taken in August and September.

11. ARGYNNIS BELLONA, *Fabr.* (*Brenthis Bellona*). Common in Ontario and Quebec. Nepigon, Fort William, Sudbury, London, Credit, Hamilton, Cobourg, Ottawa Lake Temiscamingue, P. Q., Chateauguay Basin, River Rouge district, Quebec, Little Metis, Godbout river, Lower St. Lawrence, Dalhousie, N B., Moose Factory. Flies in June, July, and August.

12. ARGYNNIS TRICLARIS, *Hubn.* Ottawa, Mer Bleue (June 16, 1893); Labrador (Couper, Low).

13. MELITÆA PHAETON, *Drury.* (*Euphydryas Phaeton*). Widely distributed, but rarely seen. Flies only about swamps and the damp margins of rivers. Has been taken at Ottawa, London, Toronto, Montreal, Quebec, Nova Scotia, New Brunswick. Flies during the latter part of June and first half of July. Food plants—Chelone glabra, Lonicera and Viburnum.

14. MELITÆA HARRISII, *Scud.* (*Cinclidia Harrisii*). Very rare, though widely distributed. Sudbury, Montreal, Quebec, St. Henri, Levis, Saguenay, Gaspé; New Brunswick, Nova Scotia, Newfoundland. Taken at the end of June and up to the middle of July. Food plants—Double-bristled Aster, Diplopappus umbellatus.

15. PHYCIODES NYCTEIS, *Doubl-Hew.* (*Charidryas Nycteis*). Taken throughout Ontario and in Quebec; not common. Nepigon, Port Arthur, Sault Ste Marie, Sudbury, London, Hamilton, Toronto Ottawa; Montreal, Quebec, Saguenay. Flies in June and July. Food plants—Helianthus (Sunflower), Actinomeris.

16. PHYCIODES CARLOTA, *Reak.* Very rare. Taken at London, (Saunders), Scarborough near Toronto, (Geddes); Nova Scotia, (Jones) "South of Lat. 40° from Atlantic to Rocky Mountains," Scudder.

17. PHYCIODES BATESII, *Reak.* Only recorded from Hamilton (Johnson) and Godbout river, P. Q. "Common in July."

18. PHYCIODES THAROS, *Drury.* (Forms MARCIA, *Edw.*; MORPHEUS, *Fabr.*) Abundant throughout Ontario, Quebec and the Maritime Provinces. Nepigon, Port Arthur, Sault Ste. Marie, Sudbury, Amherstburg, County of Essex, Point Pelee, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Rice lake, Ottawa; Montreal, River Rouge district, Eastern Townships, Quebec, Cacouna, Saguenay, Little Metis, Lower St. Lawrence, Anticosti, Labrador, New Brunswick, Nova Scotia, Cape Breton, Prince Edward Island, Newfoundland, Moose Factory. Flies during June, July and August; occasionally seen in May and September. Food plants—Chelone glabra, Aster, Actinomeris helianthoides.

19. GRAPTA INTERROGATIONIS, *Fabr.* (*Polygonia Interrogationis*). Taken throughout Ontario; rare in Quebec and Nova Scotia. Sault Ste. Marie, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa; Montreal, Compton, Quebec. Form UMBROSA, *Lint.* taken June 3 to 20, July 17, August 7. Form FABRICII, *Edw.* taken in August and September, occasionally in October. Food plants—Hop, Elm, Nettle, Linden, Celtis occidentalis.

20. GRAPTA COMMA, *Harr.* (Summer form DRYAS, *Edw.*; Winter form, HARRISII, *Edw. Polygonia Comma*). Common throughout Ontario; taken also in Quebec and Nova Scotia. Nepigon, Cameron lake, London, Hamilton, Port Hope, Cobourg, Ottawa; Montreal, Chateauguay Basin, River Rouge district, Compton, Quebec, Anticosti; Moose Factory; Dalhousie, N.B. June, July and August. Food plant—Hop, Elm, Nettle.

21. GRAPTA SATYRUS, *Edw.* (MARSYAS, *Edw.*; *Polygonia Satyrus*). Very rare. Taken in Ontario at Cameron lake, near London, and at Ottawa. In Quebec at Chateauguay Basin and Brome. Also in Prince Edward Island. Food plant—Nettle.

22. GRAPTA FAUNUS, *Edw.* (*Polygonia Faunus*). Taken throughout the Eastern Provinces of Canada. Nepigon, North of Lake Huron, Hamilton, Cobourg, Ottawa; Montreal, Brome, Missisquoi county, Quebec, Little Metis, Gulf of St. Lawrence, Nova Scotia, Newfoundland, Moose Factory. Has been taken in each month from May to October. Food plants—Green Alder, Willow, Birch, Currant, Gooseberry.

23. GRAPTA PROGNE, *Cram.* (*Polygonia Progne*). Fig 5. Common throughout the Eastern Provinces of Canada. Nepigon, Fort William, Sault Ste. Marie, Vermilion lake (Lake Huron), Sudbury, Cameron lake, Amherstburg, London, Hamilton, Credit, Port Hope, Cobourg, Peterborough, Ottawa; Montreal, River Rouge district, Eastern Townships, Quebec, Little Metis, Godbout river, Lower St. Lawrence and Bay of Chaleur, Anticosti, Restigouche river, N.B., Nova Scotia. Lat. 54° (Kirby). Flies from May to October; earliest date May 14, latest October 20. Food plants—Currant, Gooseberry, Betula papyrifera, Elm.

Fig. 5.

24. GRAPTA GRACILIS, *Grote and Rob.* (*Polygonia Gracilis*). Taken in northern Ontario and in Quebec. Nepigon, Sudbury, Quebec, Levis, Little Metis. Flies in July, August and September. Food plant—Currant.

25. GRAPTA J-ALBUM, *Boisd-Lec.* (*Eugonia J-Album*). Common throughout the Eastern Provinces of Canada. Sault Ste. Marie, Bruce Mines, north of Lake Huron, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Lake Simcoe, Ottawa; Montreal, River Rouge district, County of Grenville, Eastern Townships, Sorel, Quebec, Little Metis, Godbout river, Bay of Chaleur, Labrador, Nova Scotia. Flies during August and September; hibernating specimens are often found during the winter in houses and

appear on the wing on warm days in March and April ; taken also in May and July ; autumn brood appears in September and October. Food plant—White birch.

26. VANESSA ANTIOPA, *Linn.* (*Euvanessa Antiopa*). Abundant throughout the Eastern Provinces of Canada. Nepigon, Sault Ste. Marie, north of Lake Huron, Sudbury, Lake Simcoe, London, Credit, Toronto, Hamilton, Port Hope, Cobourg, Ottawa ; Montreal, Eastern Townships, River Rouge district, Quebec, Little Metis, Rimouski, Godbout river, Anticosti, Labrador, Newfoundland, Nova Scotia, Prince Edward Island. Hibernated specimens appear at the end of March and early in April ; common throughout the whole summer, the second brood appearing in August ; common in September, and individuals are found till the end of October. Food plants—Willow, Elm, Poplar.

27. VANESSA MILBERTI, *Godt.* (*Aglais Milberti*). As widely distributed as the preceding species. Nepigon, Sault Ste. Marie, Amherstburg, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa ; Montreal, River Rouge district, Eastern Townships, Quebec, Isle of Orleans, Little Metis, Godbout river, Saguenay, Labrador ; Newfoundland, Cape Breton, Nova Scotia, Moose Factory. Hibernated specimens appear in March and April ; more or less abundant throughout the summer ; individuals seen in October as late as the 18th. Food plant—Nettle.

28. PYRAMEIS ATALANTA, *Linn.* (*Vanessa Atalanta.*) Abundant throughout the Eastern Provinces of Canada. Nepigon, Sault Ste. Marie, London, Point Pelee, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa ; Montreal, River Rouge district, Sorel, Quebec, Little Metis, Godbout River, Anticosti, Labrador, Newfoundland, Nova Scotia, Prince Edward Island, Moose Factory. Taken from May to August ; very abundant in June when the lilacs are in blossom ; occasionally seen in October. Food plants—Nettle, Hop.

29. PYRAMEIS CARDUI, *Linn.* (*Vanessa Cardui*). Abundant everywhere. Nepigon, Sault Ste. Marie, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa ; Montreal, River Rouge district, Eastern Townships, Sorel, Quebec, Cacouna, Little Metis, Grand Metis, Godbout river, Anticosti ; Dalhousie and St. John, N.B , Nova Scotia, Newfoundland, Prince Edward Island. Flies at the end of May and throughout the summer months till September ; occasionally seen in October. Food plants—Thistle, Mallow, Hollyhock, Burdock, Wild Sunflower.

30. PYRAMEIS HUNTERA, *Fabr.* (*Vanessa Huntera*). Widely distributed, but not so abundant as the preceding species. Nepigon, Sault Ste. Marie, Point Pelee, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa ; Montreal, Quebec, Isle of Orleans, Little Metis, Godbout river, St. John, N.B., Nova Scotia. Flies in July, August and September. Food plants—Gnaphalium, Thistle, Myosotis.

31. JUNONIA CŒNIA, *Hubn.* Fig. 6. Very rare in Canada. Has been taken at Chatham, Port Stanley, London, Stratford and Ridgeway in Ontario. Food plants—Gerardia, Antirrhinum, Plantago, Linaria Canadensis.

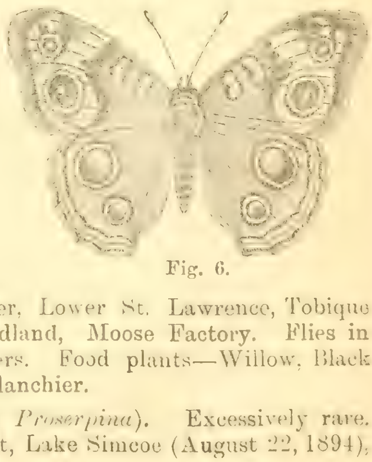
Fig. 6.

32. LIMENITIS ARTHEMIS, *Drury.* (*Basilarchia Arthemis*). Abundant throughout the Eastern Provinces of Canada. Lake of the Woods, Nepigon, Sault Ste. Marie, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Lakefield, Belleville, Ottawa, Montreal, River Rouge district, Eastern Townships, Sorel, Quebec, Sherbrooke, Little Metis, Godbout river, Lower St. Lawrence, Tobique river, N.B., Nova Scotia, Cape Breton, Newfoundland, Moose Factory. Flies in June, July and August, often seen in immense numbers. Food plants—Willow, Black and Yellow Birch, Poplar, Thorn, Plum, Cherry, Amelanchier.

33 LIMENITIS PROSERPINA, *Edw.* (*Basilarchia Proserpina*). Excessively rare. Specimens have been taken at Hamilton, Roachs' Point, Lake Simcoe (August 22, 1894), Rideau Hall, Ottawa, and Halifax, N.S.

34. LIMENITIS URSULA, *Fabr.* (*Basilarchia Ursula.*) Very rare in Canada. Has been taken at Port Stanley, London, and in Essex county, Ontario. Plentiful at London 1893 (Moffat). Food plants—Cherry, Currant, Oak, Willow, Vaccinium, Apple, Quince, Hawthorn, Plum.

Fig. 7.

35. LIMENITIS DISIPPUS, *Godt.* (*Basilarchia Archippus.*) Widely distributed, but not very abundant. Amherstburg, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Rice lake, Ottawa, Montreal, L'Orignal, Little Metis, St. John, N.B., Nova Scotia. Flies in June, July and August; occasionally seen in September and October.

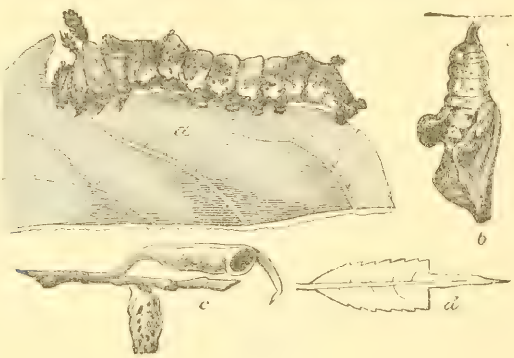

Fig. 8.

Food plants—Willow, Poplar, Plum, Apple, Oak. Fig. 7 the butterfly; fig. 8, *a*, the larva, *b*, the chrysalis, *c* and *d*, the larva case.

Sub-family *Satyrinæ.*

36. DEBIS PORTLANDIA, *Fabr.* (*Enodia Portlandia.*) Very rare. In Ontario it has only been taken at Ottawa. In Quebec at Hull and Kirk's Ferry, Montreal, Chateauguay Basin, River Rouge district, Eastern Townships, Compton, Quebec; Nova Scotia. Flies in July and August. Food plants—Grasses.

37. NEONYMPHA CANTHUS, *Boisd-Lec.* (*Satyrodes Eurydice*, Linn; *Neonympha Boisduvallii*, Harris.) Not very abundant. Has been taken at Sault Ste. Marie, Essex county, London, Hamilton, Toronto, Grafton and Ottawa (common) in Ontario; at Montreal, Compton and Quebec; Mingan Islands, Nova Scotia. Flies in June, July and August. Fig. 9. Food plants—Grasses and Sedges.

38. NEONYMPHA EURYTRIS, *Fabr.* (*Cissia Eurytris.*) Widely distributed, and not uncommon. Sudbury, Essex county, London, Hamilton, Credit, Toronto, Port

Hope, Cobourg, Rice lake, Ottawa, Montreal, Eastern Townships, Quebec. Flies in June and July. Fig. 10. Food plant—Grasses.


Fig. 9.


Fig. 10.

39. Cœnonympha inornata, *Edw.* A very rare butterfly. Taken at Massasauga Point (Macoun), Lake Winnipeg, Sault Ste. Marie, and in Newfoundland and Labrador.

40. Erebia Discoidalis, *Kirby.* The only Eastern Canadian record is its capture at Sudbury by Mr. J. D. Evans, May 12, 1889.

41. Satyrus Nephele, *Kirby.* (*Cercyonis Nephele.*) Abundant throughout the Eastern Provinces of Canada, County of Essex, London, St. Catharines, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa, Montreal, River Rouge district, Quebec, Little Metis, New Brunswick, Nova Scotia, Prince Edward Island. Flies throughout July and August; taken from June 10 to 20, in Essex county, Ontario. Food plant—Grasses.

42. Satyrus Alope, *Fabr.* (*Cercyonis Alope.*) This more southern form has been taken at St. John, N.B., and in Nova Scotia and Prince Edward Island.

43. Chionobas Macounii, *Edw.* (*Oeneis Macounii.*) This rare butterfly has only been taken at Nepigon, from June 28 to July 13. Food plant—Sedges.

44. Chionobas Jutta, *Hubn.* (*Oeneis Jutta.*) A very rare and local sub-arctic species. Has been taken at Nepigon, Ottawa, the Gomin Swamp, Quebec, Bergerville, P.Q., and in Labrador. Food plant—Carices.

Sub-family *Libytheinæ.*

45. Libythea Bachmani, *Kirtl.* (*Hypatus Bachmanii.*) Fig 11. Very rare in Canada. Has been taken at Port Stanley, London and Hamilton in August. Food plant—Celtis.


Fig. 11.

Family Lycænidæ.

Sub-family *Lycæninæ.*

46. Thecla Acadica, *Edw.* Rare. Has been taken at London, Hamilton, Ottawa, Montreal and St. Rose, P.Q. Flies in July. Food plant—Willow.

47. Thecla Melinus, *Hubn.* (*Uranotes Melinus.*) Very rare in Canada. Has been taken at London, Hamilton, Montreal. Flies in July. Food plants—Hops, Beans, Cynoglossum, Cratægus.

48. Thecla Edwardsii, *Saund.* (*Falacer*, Harris.) Very rare. Has been taken at London, Hamilton, Credit and Ottawa (rare), in July. Food plant—Oak.

49. Thecla Calanus, *Hubn.* (*Inorata*, Grote-Rob; *Falacer*, Godt.) Usually rare, but sometimes abundant. Has been taken at London, Hamilton, Ottawa and Montreal, in July and August. Food plants—Oak, Butternut, Hickory.

50. Thecla Ontario, *Edw.* Taken only at Port Stanley, Ont., by Mr. E. B. Reed, in July, 1868.

51. Thecla Strigosa, *Harr.* (*Liparops*, Scud.) Rare. Taken at Cameron Lake, London, Ottawa and Montreal, July. Food plants—Thorn, Shadbush (*Amelanchier*), Blueberry (*Vaccinium*), Plum.

52. Thecla Smilacis, *Boisd-Lec.* (*Mitura Damon*, Cram.) Has been taken only at Point Pelee, Ont., by Mr. Saunders. Food plant—Red Cedar.

53. Thecla Augustus, *Kirby.* (*Incisalia Augustus.*) Has been taken at London and Ottawa, Montreal, Bergerville and Quebec, and at Halifax, N.S.

54. Thecla Irus, *Godt.* (*Incisalia Irus.*) This very rare butterfly has been taken at Nepigon by Mr. Macoun, and at Montreal by Mr. Bowles. Food plant—Wild Plum.

55. Thecla Niphon, *Hubn.* (*Incisalia Niphon.*) Rare. Has been taken at London and Ottawa, Montreal, Chelsea, Sorel, P.Q., Halifax, N.S. Flies in May. Food plant—Pine.

56. Thecla Læta, *Edw.* (*Erora Læta.*) Very rare. Taken at London and York Mills, Ont., Beloeil Mountain, St. Joachim, St. Hilaire and Quebec. Flies during the latter part of May.

57. Thecla Titus, *Fabr.* (*Mopsus*, Hubn.; *Strymon Titus.*) Widely distributed, but rather rare in Canada. Nepigon, Sudbury, London, Hamilton, Credit, Toronto, Ottawa, Montreal, Oka, Eastern Townships, Quebec. Flies in July and August. Food plants—Wild Cherry, Oak.

58. Feniseca Tarquinius, *Fabr.* Widely distributed, but not common. Sudbury, London, Hamilton, Credit, Toronto, Stony Lake, Ottawa, Montreal, Cowansville, Township of Stanbridge, Island of Orleans, P.Q.; Halifax, N.S. Has been taken from May 24th, through the summer to September. Larva feeds upon plant lice (Aphides).

59. Chrysophanus Thoe, *Boisd.-Lec.* Taken in Ontario and Quebec, but very locally on the margin of rivers or lakes. Nepigon, London, Hamilton, Port Hope, Cobourg, Ottawa, Montreal, Lachine, Quebec, Eastern Townships. Flies in August and earlier part of September. Figs. 12 and 13. Food plants—Rumex and Polygonum.

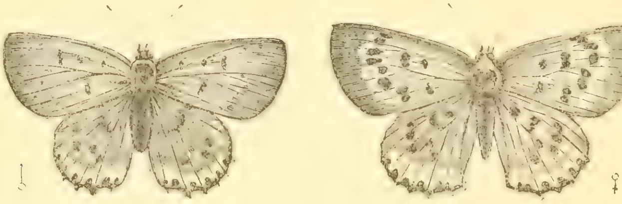

Fig. 12. Fig. 13.

60. Chrysophanus Florus, *Edw.* Five specimens of this rare butterfly were taken at Nepigon by Prof. Macoun. It has also been taken by Capt. Brown in Newfoundland.

61. Chrysophanus Dorcas, *Kirby.* Kirby's record is lat. 54°. It is reported from Labrador in July.

62. Chrysophanus Epixanthe, *Boisd.-Lec.* (*Epidemia Epixanthe*). Rarely seen, but very widely distributed; frequents the borders of swamps and peaty meadows. Has been taken at London, Toronto, Ottawa, Montreal, the Gomin Swamp, Quebec, Cape Breton, Newfoundland. Flies in July. Food plant unknown.

63. Chrysophanus Hypophlæas, *Boisd.* [*C. Americana D'Urban*] (*Heodes Hypophlæas*). Very common throughout Ontario and Quebec. Nepigon, Sault Ste. Marie, Sudbury, county of Essex, London, Credit, Toronto, Port Hope, Cobourg, Ottawa, Montreal, River Rouge district, Eastern Townships, Sorel, Quebec, Cacouna, Little Metis, Prince Edward Island, Moose Factory. Flies from the end of May to September. Food plant—Sheep's Sorrel (*Rumex acetosella*).

64. Lycæna Pembina, *Edw.* Has been taken at Cacouna, P.Q., by Mr. Saunders in July, 1866 (*Can. Ent.*, Vol. I., p. 12).

65. LYCÆNA COUPERII, *Grote.* Rare. Has been taken at Nepigon and Brantford, Ont.; Heights of Levis, Cacouna, Little Metis and Godbout river, P. Q., Anticosti, Labrador, Newfoundland.

66. LYCÆNA SCUDDERII, *Edw.* (*Rusticus Scudderii*). Locally abundant. Has been taken at Nepigon, London, Toronto, Cobourg, north shore of the St. Lawrence, Anticosti, Labrador, Hudson bay. Cape Breton. Flies at the end of May, in June and August. Food plant—Lupin.

67. LYCÆNA PSEUDARGIOLUS, *Boisd-Lec.* (Winter forms LUCIA, *Kirby*; VIOLACEA, *Edw.*: summer form NEGLECTA, *Edw.—Cyaniris Pseudargiolus*). Very widely distributed. Nepigon, Sudbury, London, Hamilton, St. Catharines, Toronto, Port Hope, Cobourg, Ottawa, Montreal, Eastern Townships, River Rouge district, Quebec, Riviere du Loup, Godbout river, Anticosti, lower St. Lawrence, Labrador, Prince Edward Island. Lat. 54° (Kirby). Appears very early in the spring, and may be found in April and May (forms *Lucia* and *Violacea*); in June and July in the more northern localities; the form *Neglecta* is found during June, July and August, and into September. Food plants—Cornus, Actinomeris, Viburnum, Acer spicatum, Willow, and a great variety of other plants (vide Scudder's Butterflies of the Eastern United States and Canada, p. 938).

68. LYCÆNA COMYNTAS, *Godt.* (*Everes Comyntas*). Not uncommon. Has been taken at Nepigon, Sudbury, London, Hamilton and Ottawa; Montreal, Lachine, Chateauguay Basin. Flies in May, June, July and August. Food plants—Leguminous plants, Lespedeza, Desmodium, Clover, Lathyrus.

Family PAPILIONIDÆ.

Sub-family *Pierinæ.*

Fig. 14.

Fig. 15.

69. PIERIS PROTODICE, *Boisd.-Lec.* (*Pontia Protodice*). Formerly common, but now rarely seen. Sault Ste. Marie, Amherstburg, Port Stanley, London, Hamilton, Toronto,

Fig. 16.

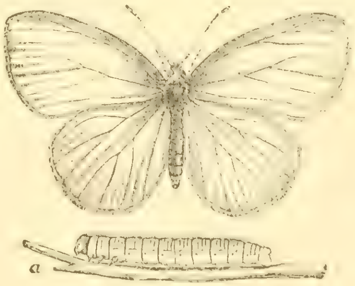

Fig. 17.

Fig. 18.

Cobourg, Lachine, P.Q. Has been taken from May to October. Food plants—Cabbage and other cruciferous plants. Fig. 14, male; fig. 15, female; fig. 16—*a* larva, *b* chrysalis.

70. Pieris Napi, *Esper.* (Forms Oleracea-hiemalis, *Harr.;* Borealis, *Grote;* Frigida, *Scud.;* Virginiensis, *Edw.;* Oleracea-æstiva, *Harris*). Taken throughout the Eastern Provinces of Canada. Formerly very abundant, but since the wide-spread intro duction of *P. rapæ*, this and the preceding species have become quite rare. Recorded from Nepigon, Sault Ste. Marie, Bruce Mines, north of Lake Huron, Sudbury, Collingwood, Amherstburg, London, Hamilton, Toronto, Port Hope, Cobourg, Ottawa, Montreal, Cowansville, River Rouge district, Quebec, Little Metis, Lower St. Lawrence, Anticosti, Labrador, Newfoundland, Cape Breton. Lat. 65° (Kirby). Hudson Bay. The form *Borealis* has been taken at Godbout river, P.Q.; *Frigida* at Mingan, Anticosti and the south and east coasts of Labrador; the aberrant form *Virginiensis* at Hamilton and Fort William. Food plants—Turnips and other cruciferous plants. Fig. 17 butterfly, and *a* the larva; fig. 18 chrysalis.

71. Pieris Rapæ, *Linn*, and aberrant form *var* Novæ Angliæ, *Scud.* Since its introduction to this country at Quebec, in 1858, it has spread over a large portion of the continent, and is everywhere one of the commonest butterflies. Flies from April to

Fig. 19.

Fig. 20.

Fig. 21.

October. Food plants—Cabbage and other cruciferous plants, mignonette, stocks. Fig. 19, male butterfly; fig. 20, female; fig. 21—*a* larva, *b* chrysalis.

72. Colias Cæsonia, *Stoll.* (*Zerene Cæsonia*). Mr. Scudder gives "Southern Ontario" as one of its localities, but I can find no recorded place of capture. Mr. Moffat tells me that it was taken at Long Point, Lake Erie. Food plants—Clover, Amorpha.

73. Colias Eurytheme, *Boisd.* [Forms Keewaydin, *Edw.*; Eriphyle, *Edw.*] (*Eurymus Eurytheme*). Abundant north of Lakes Superior and Huron; occasionally taken in more southern localities. Nepigon, Fort William, Port Arthur, Bruce Mines, Sault Ste. Marie, London, St. Catharines, Port Hope (Oct. 15), Ottawa, Hull, Montreal, Missisquoi county, Quebec. Food plant—White Clover.

Fig. 22.

Fig. 23.

74. Colias Philodice, *Godt.* (*Eurymus Philodice*). One of the commonest butterflies throughout the Provinces of Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island. Abundant from the middle of May to September; occasionally taken as early as April 9th, and as late as October 19th. Food plants—Clover, Pea, Lupin. Fig. 22, male; fig. 23, female.

75. Colias Interior, *Scud.* (*Eurymus Interior*). Abundant north of Lakes Superior and Huron; occasionally taken further east. Nepigon, Port Arthur, Fort William, Spanish river, Georgian bay, Sudbury, Ottawa, Montreal, Owl's Head Mountain, Quebec, Heights of Levis, Moose Factory. Flies in July and August. Food plant—Willow.

76. Colias Interior, *var* Laurentina *Scud.* Is recorded from Montreal (Caulfield, July, 1874); Quebec (Fyles); Godbout river, Anticosti, Mingan, Labrador, Newfoundland, Prince Edward Island, Cape Breton.

77. Terias Nicippe, *Cram.* (*Xanthidia Nicippe.*) This southern butterfly has been once taken at Point Pelee, Ont. Food plant—Cassia.

Terias Mexicana, *Boisd.* has also been taken at Point Pelee, by Mr. Saunders, June 29, 1882.

78. Terias Lisa, *Boisd-Lec.* (*Eurema Lisa.*) Has been taken at Point Pelee (June 29, 1882, Saunders); Port Stanley (August, 1861); London, Hamilton (Moffat, June 23, 1882,) Food plants—Clover, Cassia.

Sub-Family, *Papilioninæ.*

79. Papilio Ajax, *Linn.* [Form Marcellus, *Boisd.*] (*Iphiclides Ajax.*) Occasionally taken in June in the extreme southern parts of Ontario, North Ridge, county of Essex, Point Pelee, Long Point, Ridgeway, Komoka, near London. Food plant—Pawpaw.

Fig. 24.

80. Papilio Turnus, *Linn.* (*Jasoniades Glaucus.*) Abundant throughout the Provinces of Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island; also in Newfoundland. Flies during the latter part of May, throughout June and part of July, sometimes in enormous numbers. Food plants — Apple, Thorn, Aspen, Poplar, Willow, Cherry, Alder, Basswood, Oak, Black and White Ash, Birch, Aspen, Tulip wood, Amelanchier Canadensis. Fig. 24, butterfly; Fig. 25, caterpillar.

Fig. 25.

81. Papilio Cresphontes, *Cram.* (*Papilio T*

Fig. 26. Spreading gradually through southwestern Ontario. Has been taken in the

county of Essex, at Amherstburg, Sandwich, Windsor, Belle Isle, Chatham, Point Pelee, St. Thomas, Long Point, Thedford, Dunnville, London, Dundas, Hamilton, Ridgeway,

Fig. 26.

Toronto, Roach's Point, Lake Simcoe, Sparrow lake. In Quebec at Chateauguay Basin and at St. John, N. B. Flies in June, July and August. Food plants—The Citrus family, Rutaceæ, Prickly Ash, Hop-tree (*Ptelea trifoliata*) Dictamnus fraxinella, Ruta graveolens.

82. PAPILIO BREVICAUDA, *Saunders.* Taken only in the extreme east; Godbout River, Anticosti, Labrador, Newfoundland, Gaspè and Dalhousie, N. B. Food plants—Ligusticum, Pastinaea.

Fig. 27.

83. PAPILIO ASTERIAS, *Fabr. Papilio, Polyxenes.*) Fig. 27. Abundant throughout the western peninsula and eastern parts of Ontario; not common in the Province of

Quebec. County of Essex, Amherstburg, London, West Flamboro, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa, Montreal, "150 miles east and west of Quebec" (Bowles), Lorette, Cacouna, Little Metis, Labrador, New Brunswick, Newfoundland. Flies at the end of May and through June, July and August; most abundant during the last-named month. Food plants—Celery, Carrot, Parsley and other umbelliferous plants.

84. Papilio Troilus, *Linn.* (*Euphœades Troilus.*) Confined to the western peninsula of Ontario, where it is common. County of Essex, Point Pelee, Dunnville, London, West Flamboro, Hamilton, St. Catharines, Credit. Flies during June, July and August. Food plants—Spice-bush, Sassafrass.

Fig. 28.

85. Papilio Philenor, *Linn.* (*Laertias Philenor.*) An occasional visitor to south-western Ontario. Long Point, Ridgeway, Woodstock, West Flamboro, Hamilton, Grimsby, Humber Plains, Toronto. Only seen in the month of June. Food plant—Dutchman's Pipe (*Aristolochia sipho.*) Fig. 28, butterfly; Fig. 29 *a* and *b*, chrysalis; Fig. 30, caterpillar.

Fig. 29.

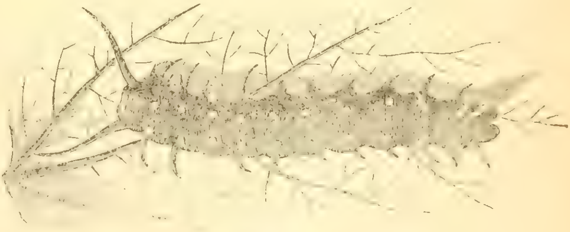

Fig. 30.

Family *Hesperidæ.*

86. Carterocephalus Mandan, *Edw.* Taken in the northern parts of Ontario and in Quebec. Nepigon, Sault Ste. Marie, St. Joseph's Island, Lake Huron, Sudbury, Bobcaygeon, Ottawa, Lake Mistassini, Lachine, Compton, Bergerville, Levis, Quebec, Godbout river, Anticosti, Labrador. Flies in June and July. Food plant—Grass.

87. Ancyloxypha Numitor, *Fabr.* (*Heteropterus Marginatus, Harris.*) Widely distributed but extremely local. Point Pelee, London, Hamilton, Grimsby, St. Cathar-

ines, Township of Shefford, River Yamaska, P. Q. Has been taken in June, August and September. Frequents low marshy places. Food plant—Grass.

88. Pamphila Massasoit, *Scud*, (*Poanes Massasoit.*) Only recorded by Mr. Scudder as from "Ontario (Saunders)"

89. Pamphila Zabulon, *Boisd.-Lec.* [Forms Hobomok, *Harris*; Pocohontas, *Scud.*] (*Atrytone Zabulon*). Not uncommon in one or other of its forms throughout Ontario and Quebec. Taken at Nepigon, Sudbury, county of Essex, London, Hamilton, Credit, Toronto, Ottawa. Montreal, Chateauguay Basin, Compton, Quebec, Dalhousie, N. B., Nova Scotia. Flies in June and July. Food plant—Grass.

90. Pamphila Manitoba, *Scud.* (*Erynnis Manitoba.*) Inhabits northern Ontario and Quebec. Nepigon, Sudbury, Kirk's Ferry, Quebec, Levis, Cacouna, Riviere du Loup, Little Metis, Gaspe. Taken in July, August and September.

91. Pamphila Leonardus, *Harris.* (*Anthomaster Leonardus.*) Taken sparingly in Ontario and Quebec. London, Hamilton, Credit, Toronto, Port Hope, Chelsea, Hull, Montreal, Chateauguay Basin. Flies in July and September. Food plant—Grass.

92. Pamphila Otho, *Sm.-Abb.* [Variety Egeremet, *Scud.*], (*Ætna, Scud*). Very rare. Has been taken at Hamilton, London, Prescott, and in the Eastern Townships, P. Q. (Fyles).

93. Pamphila Peckius, *Kirby.* [Wamsutta, *Harris*] (*Polites Peckius.*) Common and very widely distributed. Nepigon, Sudbury, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa, Montreal, Quebec, Little Metis, New Brunswick, Nova Scotia, Cape Breton, Moose Factory, Prince Edward Island. Flies in June, July, and occasionally in August. Food plant—Grass.

94. Pamphila Mystic, *Scud.* (*Thymelicus Mystic.*) Frequents the same localities as the preceding. Nepigon, Sudbury, London, Hamilton, Port Hope, Ottawa, Montreal, Chateauguay Basin, Quebec, Cacouna, Ha! Ha! bay; Nova Scotia, New Brunswick and Prince Edward Island. Flies in June, July and August. Food plant—Carex.

95 Pamphila Cernes, *Boisd.-Lec.* [Ahaton, *Harris.*] (*Limochores Taumas, Fabr.*) Very abundant throughout eastern Canada. Nepigon, London, Hamilton, Credit, Toronto, Port Hope, Ottawa, Montreal, Chateauguay Basin, Eastern Townships, Quebec, Nova Scotia, Cape Breton, Prince Edward Island. Flies in June and July. Food plant—Grass.

96. Pamphila Manataaqua, *Scud.* (*Limochores Manataaqua.*) The only Canadian localities I have found are "Canada West" (British Museum Catalogue); Prince Edward Island (Macoun.)

97. Pamphila Metacomet, *Harris.* (*Euphyes Metacomet.*) Not common. Has been taken at Nepigon, Sudbury, London, Hamilton, Ottawa, Montreal, Heights of Levis. In July. Food plant—Carex.

98. Pamphila Pontiac, *Edwards.* (*Limochores Pontiac.*) The only Canadian locality is Montreal (Caulfield, teste Strecker.)

99. Pamphila Dion, *Edw.* (*Limochores Palatka, Edw.*) Taken only at Hamilton by Mr. Moffat.

100. Pamphila Viator, *Edw.* (*Phycanassa Viator.*) This southern butterfly has been taken at Hamilton by Mr. Moffat, and on the Humber Plains near Toronto by Mr. Geddes.

101. Pamphila Vitellius, *Sm.-Abb.* [*Delaware, Edw.; Logan, Edw.*] Taken only at London by Mr. Saunders.

102. Amblyscirtes Vialis, *Edw.* Rare. Has been taken at Nepigon, Sudbury, London, Ottawa, Chelsea, Montreal and Eastern Townships. In June and July. Food plant—Grass.

103. Amblyscirtes Samoset, *Scud.* Occurs even more rarely than the preceding. Has been taken at Ottawa, May 27, 29; Eastern Townships and Levis, P.Q., Nova Scotia. Flies in the end of May and in June.

104. PYRGUS TESSELLATA, *Scud.* (*Hesperia Montivaga*, *Reak*). A southern and western species which has only been reported from Essex county, Ontario. (Lowe, Can. Ent., vii., p. 140.)

105. PYRGUS CENTAUREÆ, *Ramb.* (*Hesperia Centaureæ*). A northern circumpolar species. It has been taken at Wabigoon, on the C. P. R. (about 200 miles west of Fort William), and in Labrador (Low).

106. NISONIADES BRIZO, *Boisd.-Lec.* (*Thanaos Brizo*). Widely distributed, but not very common. Sudbury, London, Hamilton, Toronto, Ottawa, Montreal, Quebec, Nova Scotia, Prince Edward Island. Flies in June. Food plant—Scrub Oak.

107. NISONIADES ICELUS, *Lint.* (*Thanaos Icelus*). Abundant locally, but not common. Nepigon, Sudbury, Hamilton, Ottawa, Montreal, Quebec, Nova Scotia. Flies in June and July. Food plants—Aspen, Willow, Witch-hazel.

108. NISONIADES LUCILIUS, *Lint.* (*Thanaos Lucilius*). Only recorded in Ontario from London and Ottawa. Flies in May, July and August. "In 1893 so abundant at Ottawa as to be noticeably injurious to garden Columbines" (Fletcher). Food plant—Wild Columbine (Aquilegia Canadensis).

109. NISONIADES PERSIUS, *Scud.* (*Thanaos Persius*). Has been sparingly taken in the county of Essex, London, Hamilton, Toronto, Ottawa and at Saguenay, P. Q. Flies in May and June. Food plants—Willow, Poplar.

110. NISONIADES MARTIALIS, *Scud.* (*Thanaos Martialis*). A southern species, which has been taken at London, Hamilton and Toronto.

111. NISONIADES JUVENALIS, *Fabr.* (*Thanaos Juvenalis*). Not common. Has been taken at London, Hamilton, Toronto, Cobourg, Ottawa (rare). Flies in May and early June. Food plants—Oak and various leguminous plants.

112. PHOLISORA CATULLUS, *Fabr.* Not common. Has been taken in the county of Essex, Point Pelee, London, Hamilton, Toronto, Eastern Townships and Quebec. Flies in June Food plants—Chenopodium, Aramantus.

113. EUDAMUS ELECTRA, *Lint.* (*Thorybes Electra*). This butterfly has only been taken by Mr. Moffat at Hamilton. The only specimen, a female, is in the possession of Dr. Holland, of Pittsburg, Penn.

114. EUDAMUS PYLADES, *Scud.* (*Thorybes Pylades*) Common in certain localities. Has been taken at Nepigon, Sudbury, London, Hamilton, Ottawa, Montreal, Chateauguay Basin. Flies in May, June and July. Food plants—Clover, Lespedeza and other leguminous plants.

115. EUDAMUS BATHYLLUS, *Sm.-Abb.* (*Thorybes Bathyllus*). This southern species has been taken in the county of Essex, at London, Hamilton, Toronto, Rice lake, Ottawa. Flies in June and July.

116. EUDAMUS TITYRUS, *Fab.* (*Epargyreus Tityrus*. Very widely distributed throughout Ontario and Quebec; common, but not numerous. County of Essex, Point Pelee, London, Hamilton, St. Catharines, Credit, Toronto, Port Hope, Ottawa, Montreal, Chateauguay Basin, Quebec. Flies in May, June and July. Food plant—Locust, Acacia, Lathyrus palustris, Apios tuberosa.

POSTSCRIPT.—Since this list was prepared I have learnt that the following species has been taken within our limits:

117. LYCÆNA AQUILO, *Boisd.* [*Franklinii*, *Curtis*]. This northern species was taken at Nepigon by Mr. Fletcher, July 7, 1894. It is also reported from Labrador, Hudson straits, Newfoundland (Gosse).

The following species do not come strictly within the limits that we have adopted, but may be mentioned as possible additions to our fauna:

ARGYNNIS POLARIS, *Boisd.* Hudson straits (Payne and Bell).

CHIONOBAS CALAIS, *Scud.* Rupert House, Hudson bay; Newfoundland.

CHIONOBAS TAYGETE, *Hubner.* Hudson straits (Payne).

CHIONOBAS SEMIDEA, *Say.* Labrador, Hudson straits, Newfoundland.

CHIONOBAS CRAMBIS, *Frey.* Hudson straits (Payne).

CHIONOBAS ŒNO, *Boisd.* Labrador (Couper).

CHIONOBAS BORE, *Esp.* Labrador (Couper).

LYCÆNA ASTER, *Edw.* Newfoundland (Gosse, Mead).

LYCÆNA LYGDAMUS, *Doubl.* Labrador (Couper).

PAPILIO MACHAON, *Linn.* Rupert House, Hudson bay (Payne).

COLIAS BOOTHII, *Curt.*, *var.* CHIONE, *Curt.* Hudson straits (Payne, Geddes, Can. Ent., xxi., 59).

COLIAS HECLA, *Lef.* Hudson Straits (Payne).

COLIAS EDWARDSII, *Behr.* Fort William (Geddes).

COLIAS NASTES, *Boisd.* Labrador ; Hudson straits (Payne).

COLIAS LABRADORENSIS, *Scud.* Labrador.

COLIAS SCUDDERII, *Reak.* Labrador, Hudson bay.

THE PITCHER-PLANT MOTH.

(*Exyra Rolandiana*, Grt.)

BY JAMES FLETCHER, OTTAWA.

There are few of our native plants of so much interest as our native pitcher-plant, *Sarracenia purpurea*, from its peculiar beauty and the curious shape of its leaves and flowers, and there are few insects more interesting than the pretty little moth *Exyra Rolandiana*, of which the caterpillars or cocoons may generally be found by making a close search inside the leaves of the pitcher-plant during the month of June or early in July.

This moth was first described by Mr. A. R. Grote in *Psyche*, vol. ii., 1877, page 38, from specimens reared by Mr. Roland Thaxter, at Newton, Mass. It is a small, thick-set insect, about three-eighths of an inch in length, of a dark, metallic, purplish hue which on the forewings is relieved by a yellowish discal patch. The base of the wings is deep red. The dark color on the wings of the females is much blacker than in the other sex. The hind wings in both sexes are black. When at rest the wings are sloped like those of a *Plusia*.

In the *Canadian Entomologist* for 1874, vol. vi., page 207, Prof. Riley contributed an article "On the Insects More Particularly Associated with *Sarracenia variolaris*," and in this article he treats of the closely allied moth, *Xanthoptera semicrocea*, in a most entertaining manner, giving figures of all its stages. The insect-catching power of the pitcher-plants is well known and has been frequently referred to. By an examination of the decaying remains, which may be at any time found in the leaves, it will be seen that insects of almost all orders fall a prey to these treacherous death traps. Ants, however, seem to far outnumber all other kinds of insects, and Prof. Riley suggests that the acidulous properties which their decomposing bodies give to the liquid, with which the lower portion of the pitcher is always filled, render it all the more potent as a solvent of the bodies of the entrapped insects, from which doubtless the plants derive benefit, if indeed they be not, as some believe, truly insectivorous. The leaf of the pitcher plant, from its shape, namely that of a hollow tube tapering to a point at the base, swollen a little above the middle and contracted at the mouth, forms a trap from which it is very difficult for any insects to escape when they have once entered. In addition to the shape of the leaf there are other characters which add to the difficulty of egress. Above the

mouth of the pitcher is a wide expanded hood with stiff bristles pointing down towards the opening, and any insect settling upon this expansion is unconsciously directed toward the danger lying beneath, by finding it, when attempting to walk, much easier to go in the direction of the bristles. The orifice of the pitcher is highly polished and difficult for most insects to find a footing upon; experience shows that a great many fall into the trap. Once inside, they are met with new dangers; the lower third of the pitcher is filled with water, and should they succeed in crawling out of this, the upper portion of the tubes down to the swollen part is thickly beset with fine bristles pointing downward, so that it is almost impossible for luckless captives to regain their liberty. There are, however, a few kinds of insects which are able to brave these dangers with impunity. One of these is a large flesh fly, of which the white maggots may generally be found during the summer revelling in the decomposing remains of other insects at the bottom of the pitcher. When full-grown, they bore their way out through the walls of the leaf and pupate in the surrounding moss. Another species is the pretty little moth referred to above, of which I have studied a few specimens every summer for the last three years.

My first acquaintance with this insect was upon finding the moth inside a pitcher in June, 1890. Since that time I have collected similarly located larvæ of various sizes and the cocoons. I have also bred the larvæ from after the third moult in confinement.

Mr. Roland Thaxter says: "The larvæ of *Exyra Rolandiana* may be found in the smaller leaves of *Sarracenia purpurea* in this vicinity (Newton, Mass.) as soon as the snow is off the ground early in spring, apparently having moulted two or three times; they are then of a dull reddish brown and about 6 mm. long. As soon as the weather grows warmer, they increase in size rapidly, and, having eaten the leaf in which they have hibernated, betake themselves to the larger leaves, which they begin to eat after having made a hole near the base to let the water out and after having spun a close web over the mouth. The larva reaches its full growth about the first of May and later, when it is about 20mm. long, of a dull carmine or brown color, lighter, sometimes white, between the segments. The cocoon is spun in the leaf of loose white silk, the larva changing to a pupa a few days after spinning. The imago appears early in June. There is a good deal of variation in the color of the females, some being much brighter than others. The following are the extreme measurements of both sexes: males, 26-20mm., females 21-16mm. In its habits it resembles *E. semicrocea*, generally backing down towards the bottom of the leaf when disturbed, and using its wings in ascending. I notice that the frenulum at the base of the wings is very long in this species, and, as well as I could see, the moth seems to use it when crawling up the leaf. This species is very delicate and difficult to rear."

I have never found the larva at Ottawa before the beginning of June, and they had most of them at that time moved to a new leaf, but their presence on a plant was easily detected by the brown dead patch on the leaf where they had fed the year before and which showed plainly on the outside. The leaves containing the larvæ, moreover, as often as not, had some water in them. This, of course, may have resulted from the *débris* at the bottom having stopped up the hole observed by Mr. Thaxter. On one or two occasions when the larvæ were shaken off into the water, they floated on the top and easily regained their places on the sides of the pitcher. In all instances the surface of the leaf was eaten at one place only, generally near the top inside the leaf, the outside skin being left intact. The larva is sluggish and seldom moves from its feeding ground until full grown, when it spins a loose cocoon of very fine cobwebby silk, either against the side of the pitcher or, in two instances, beneath the surface of the mass of decomposed insects and its own excreta. The web over the mouth of the pitcher, although very fine, seems to keep out quite effectually all other insects after the leaf has been taken possession of by the larva. The time of appearance of this moth is rather extended. Moths have been taken here by the first week in June, and at the same time a very small larva was found which did not give the perfect insect until the 12th of July.

The following is a description of this caterpillar when full-grown: Length, when extended, three-quarters of an inch; spindle-shaped; distinctly segmented; general outline closely resembling the larva of *Xanthoptera semicrocea*, figured by Prof. Riley on page 208 of the *Canadian Entomologist*, vol. vi., but lacking the fleshy processes of the

abdominal segments ; head and first segments small ; segments 2-7 gradually enlarging to 3 mm., and then tapering to the posterior extremity ; each segment velvety claret color, the velvety hairs only in the central part of the segments ; the intrasegmental sutures smooth, pale, in some specimens almost white ; head white, marked symmetrically on each side with three black marks, the uppermost almost round, the middle one crescent-shaped, and the lowest, above the ocelli, comma-shaped ; spiracles brown, ringed with black ; on each segment about six small black tubercles bearing slender tawny bristles ; thoracic feet and pro-legs darkened externally. When walking this caterpillar has the same half-looper appearance as the caterpillars of the *Plusias*, due to the fact that like them it has only two pairs of abdominal pro legs. At the same time the fore part of the body is moved from side to side with a wavering motion.

Before spinning its cocoon the caterpillar ceases feeding for about a day and then spins its flimsy cocoon through which the chrysalis can be easily seen. The pupal stage lasts between 15 and 19 days. The moth when it emerges crawls up the sides of the pitcher and easily forces its way through the gossamer-like covering.

CATASTEGA ACERIELLA Clemens, SEMASIA SIGNATANA Clemens.

By The Rev. T. W. Fyles, South Quebec.

In my notes on "The Season of 1893," published in the Society's last Report, I described the Catastega larva and pupa. In telling of the habits of the larva I said, "Then it bites away portions of the inner skin of the leaf and proceeds to make itself a case" This, without addition may be somewhat misleading.—*It makes its case of its excrementa.* The larva vacates its case, or rather *tube*, and drops from the tree about the 15th of September. The perfect insect appears in the middle of April next ensuing. The following is a description of it :

Length of body one-fourth of an inch. Expanse of wings five-eighths of an inch. Colors, grey and brown. Antennæ filiform, grey ; palpi, large and pale grey ; face, clothed with long, pale grey, feathery scales ; eyes, protuberant, pale grey ; thorax, grey ; abdomen, brownish grey ; legs, feathered throughout, pale grey—the tarsi barred with brown on the upper side, as are also the tibiæ of the middle and foremost pairs ; primaries, pale grey, having numerous, dark-brown lines, running from the costa with a backward curve for about one-third of the width of the wing ; having also three conspicuous patches of dark brown, one—somewhat triangular—in the centre with an angle touching the costa, and one on each side of this, running from the inner margin about half-way across the wing—the base and outer angle of the wing are clouded with brown ; secondaries, brownish grey, darkening towards the hind margin ; fringes of all the wings grey.

On April 17th I sent specimens of the moth to Professor Fernald, and said :—"I dare say the moth is known under another name. If this be the case, which name will stand good ?" To this he very kindly replied. "I am in receipt of your letter enclosing specimens of *C. aceriella* Clem. which prove to be *Semasia signatana* Clem. and this last name will hold, because it was given to an imago which was properly described, and the type is still preserved in the collections of the Am. Ent. Soc. in Phil., and because the former name and description were for the early stages of some unknown insect."

NOTES ON A FEW CANADIAN COLEOPTERA.

By W. Hague Harrington, F.R.S.C., Ottawa.

Hippodamia 5, signata, Kirby.—Fig. 31 (much enlarged) In the summer of 1893 I collected in a swampy meadow some coccinellids with the hope of obtaining hymenopterous parasites from them. In this I was not successful, but from a specimen of the species named there emerged two individuals of a small, white hair snake (Gordius ?) about two inches long.

Fig. 31.

Brachyacantha ursina, Fab. This beetle has been very abundant at Ottawa the past two seasons, although formerly I had only found occasional individuals. During July and August it occurred commonly upon milk-weeds About the end of April last year, in examining colonies of ants under stones, I discovered in a colony of the small brown ant (*Lasius alienus*) four larvæ which were devouring plant-lice, which were feeding upon the roots of grass after having been wintered by the ants. These larvæ were whitish and powdery, like the aphides themselves, and were 6 mm. long and 2 mm. wide tapering only slightly toward the extremities. Recognizing them as coccinellid larvæ, I secured them and placed one in alcohol. The remaining three were kept in a small jar with a few of the aphides, but they did not appear to eat any more, and a day or two later had gathered in a group and formed for themselves almost globular cocoons of white flocculent secretions, in which they pupated. The imagos emerged between the 15th and 20th June, and proved to be *B. ursina*, whose larval habits have not been described so far as I can ascertain with the literature at hand.

Antherophagus ochraceus, Melsh. This beetle is found sparingly upon flowers, such as the spiked-maple, goldenrod, etc. On one occasion I observed a humble bee (*Bombus terricola*), upon a currant bush, and evidently in trouble. Closer observation showed that some small insect had seized her by the end of her tongue, and was retaining its hold in spite of the bee's frantic exertions to dislodge it with her front legs. I secured the bee in my cyanide bottle and when she was dead found that her assailant was still attached to her tongue, and was a specimen of *A. ochraceus* They are still together in my cabinet. Dr. Riley has, I think, mentioned this species as occurring in the nests of Bombus, but I cannot find the reference at present. Had the beetle in this instance merely attached itself to the bee by accident, or was it intent on getting free transportation to the bee's nest ? If the latter were the case it probably intended to attach itself to the leg, and seized the tongue in mistake.

Oestodes tenuicollis, Rand. This rather pretty elater has been one of the beetles which I had always been expecting to turn up at Ottawa, but which I had never found until this summer, when several were taken upon goldenrods on an island below the city, and one also in a field in the suburbs.

Poecilonota cyanipes, Say. This fine little buprestid is rare, and only occasionally found upon willows and poplars, upon the former of which one specimen was taken during the past season.

Anthaxia aeneogaster, Lap., (*inornata*, Rand.) The habits of this pretty little species appear to be somewhat different to those of our other species of Anthaxia, which are generally obtained by beating trees during the summer, whereas this species usually is found earlier in the season, and nearly always on flowers, such as trilliums, etc. Three were taken on the 20th June last in the flowers of *Cypripedium pubescens*, the Yellow Ladies' Slipper.

Hydnocera difficilis, Lec. Last spring I collected a number of the small, round, flat spider nests, which may be commonly found adhering to stones. They are of a tough consistence, and somewhat glistening surface, but I do not know the name of the species which constructs them. They are frequently infested by a Pezomachus, the oblong cocoon of which can easily be seen when the spider's cocoon is held up to the light. From one of the cocoons which I supposed to contain a Pezomachus there came forth a beetle of this species. The hole cut by it was more irregular than the orifice by which the hymenopterous parasite issues, and exposed to view within the exuviæ of the beetle.

Cupes concolor, Westw. Some years ago I captured one of these beetles when beating shrubbery on the edge of a small lake, but it did not turn up again until this year, when one was found in my bed-room on the evening of July 28th. It had apparently flown in the window, attracted by the electric lamp.

Saperda lateralis, Fab. On June 24th I captured near Hull a beautiful example of this elegant longicorn. My only previous capture of the species was made with a paddle as I was crossing the Ottawa. My canoe was in mid-stream when I saw a rather uncommon looking beetle flying by, and I could just reach it with the paddle, to the wet surface of which it stuck; such are the accidental captures which do not throw much light on the localities to search for further specimens.

Chalmys polycocca, Lac. This beetle was more than usually abundant the past season, and did considerable damage to blackberries, the foliage of which was often so badly riddled as to be virtually destroyed. The beetle is readily recognized by its almost globular, bronzed and corrugated body, and the grubs can be easily found, as they live in black ob-conical cases which are quite conspicuous upon the riddled leaves and stems. A number of the larval cases were collected and kept in breeding jars with a hope of securing parasites, but only beetles were obtained. From one pupa case, however, there sprouted a small slightly club-shaped fungus about 4 mm. long.

Phyllodecta vulgatissima, Linn. This beetle occurred in great abundance upon willows on an island below the city, and during the months of July and August the beetles and their larvæ almost entirely destroyed the foliage of some low-growing species. The beetle had never previously been observed in such numbers near Ottawa.

Diabrotica longicornis, Say. This insect was described in 1824 from specimens found near the Rocky Mountains, and is a common species in several of the United States, especially in Illinois, Iowa and Missouri. It has been frequently a very serious pest to corn, in the roots of which the grubs burrow. A very complete account of its life-history and ravages may be found in a report by Prof. Forbes (10th Rept. of State Entomologist, Illinois), which contains good illustrations of the various life stages of the insect. I do not find that it has ever been recorded from Canada, nor can I find any mention of the northerly and easterly limit of its distribution. It will therefore, I think, be of considerable interest to record the occurrence of this pretty little greenish beetle at such a far easterly point as the head of the Bay of Fundy. On Sept. 8th, 1890, I found it quite abundantly on the Big Tantramah Marsh near Aulac, New Brunswick, which is almost on the boundary line between that province and Nova Scotia. It may be added that these and similar dyked lands are always spoken of as the "marsh." The beetles were found upon the flower-heads of the common large thistle (*Cnicus lanceolatus*), apparently feeding upon the pollen. Thirty or more were easily secured upon a small patch of the thistles. But little corn is grown in the neighborhood, nor am I aware of the occurrence there of ragweed, in which the beetle has also been stated to breed, and it seems probable that it must find a living in the roots of some of the larger grasses.

Nacerdes melanura, Linn. This beetle, introduced from Europe, is, according to Dr. Hamilton, rather rare in America. Some years ago I captured one on a wharf in Sydney, N.S., and on June 26th last I found another on a building in this city.

Corphyra Newmani, Lec. Four or five springs ago I noticed a curious behavior on the part of this beetle. Specimens were twice found mounted upon *Melöe niger*, but for what purpose was not apparent, unless they were attracted by the oil exuded by the blister-beetle. The specimen which I have in my cabinet is dated May 22nd. It is a male, as is also the Meloe upon which it was captured. The species is not uncommon here on flowers.

Melöe sps. ? Frequently when collecting hymenoptera I find upon some of the smaller bees, such as Halictus, the minute triungulin larvæ of Meloe. They generally are attached to the posterior femora or to the hairs at the base of the abdomen, and several are sometimes found on one bee. One day last season I saw what seemed to me a new species of bee with a red metathorax, but to my disappointment, when I had carefully netted it, I found it to be only the very common *Prosopis affinis*, upon which more than half a dozen

of the triungulins had clustered, so as to entirely cover the metathorax. At least two species of these triungulins are common, one being yellowish, the other brownish. They occur most frequently on *Ceratina dupla* and *Halictus discus?* during the month of June. I have also found them upon the catkins of willows waiting for the visits of these bees, so as to be carried to their nests.

Barynotus Schœnherri, Zett. This European weevil, which I recorded in Vol. 23, p. 21, as occurring at Sydney, N. S., in 1884, was again found there by me last September, at a point some distance from the shore where I formerly took it. The specimen was also much fresher in appearance, and there can be no doubt that the species is definitely settled there.

Otiorhynchus sulcatus, Fab., and *Otiorhynchus ovatus*, Linn., also occur somewhat commonly at Sydney, but are very much less common than the next species to be mentioned.

Otiorhynchus rugifrons, Gyll. In a dry rocky pasture where I collected one morning, this beetle was found in great abundance. Under nearly every stone several would occur, either clinging to the under surface, or upon the roots of the grasses, etc. Great quantities of the ejectamenta of toads were seen, and the pellets were composed almost entirely of the remains of this beetle, with an occasional specimen of the preceding species. Thousands must have so perished, as fifty or more were required for one meal by the toad, and I imagine that even then he got very little nourishment, in proportion to the mass of indigestible matter swallowed.

Hypomolyx piceus, De G. This fine northern weevil does not appear in our label list, although under the synonyms *H. pinicola*, Couper, and *H. pineti*, Fab., it is recorded from several points in Canada. Last year I took a dead specimen in the leaf of a pitcher-plant some 30 miles from the city (near Casselman), but to-day (17th Nov.), in searching for *Staphylinus erythropterus* I found four fine fresh specimens at the base of a larch tree, just under the moss. From the condition of the beetles and their being all on the same tree, it seems evident that they had been bred in it; the only conifers near by were larches and cedars.

Conotrachelus anaglypticus, Say. This handsome little weevil was an addition to my Ottawa list this season; six specimens having been taken on goldenrods, upon the island previously mentioned, on August 18th and 25th.

FOOD, FEEDERS, AND FED.

By Rev. Thomas W. Fyles, F.L.S., South Quebec.

On the cover of that interesting magazine "Science Gossip," are represented incidents in the feud that seems to have known no truce since the beginning of created things. A fish has made a spring from the water to catch a fly, but has itself been seized, at one end by a kingfisher and at the other by a pike. Underneath, a water-insect is making every effort to escape from a dytiscus, whilst a perch is in eager chase of the pursuer, unmindful of the monster that with open mouth is close at its own tail. The consummation of such a series of efforts is described in another publication, which, with half the title of that just mentioned, makes a larger claim, viz., "Science." Dr. Charles C. Abbott tells us that he found a bull-frog (*Rana Catesbyana*) with enormously distended sides, and that on examining the contents of its stomach, he found a garter-snake (*Eutænia sirtalis*) eighteen inches long, and a field-mouse (*Arvicola riparia*). Close examination shewed that the snake was in the very act of swallowing the mouse when the bull-frog made a meal of both of them. Science, Vol. III, p. 67.

Snakes.

I once saw a large garter-snake swallow a full-grown toad. This toad had held possession of a flower-bed in my garden. In it no doubt it had done me good service by catching various insect intruders. When I came upon the scene the snake held the toad

by one of its hind legs. There was no attempt at resistance. The toad, charmed, or overcome by terror, quietly submitted, and the snake drew in both legs of its unfortunate prey as far as the haunches. At this stage of the proceedings, regardful of the toad's services, I interfered, and disturbed the snake by poking it with my walking-stick. It glided away ; and I supposed, of course the toad would make off too. But no, it drew itself together and sat, as stolid as Mark Twain's celebrated frog. After a few minutes the snake came sidling back again. It rubbed its head on the ground, first on one side and then on the other, with the fawning motions of a kitten, and so approached the toad which remained apparently quite apathetic. It seized it by the hind legs as before. The gorging process went on smoothly until the trunk of the toad was reached—then came the strain ! I could see the upper jaw of the snake cautiously raised and slightly protruded. Then fresh hold was taken, and the bite with effort secured. As this process was continued, the forward part of the toad's body was more and more distended with the displaced viscera and compressed air. By and by the fore-legs of the toad stuck out angularly, one on each side, and seemed to offer insurmountable difficulties—but no, they in turn were engulphed ; and the last motion I saw of the unfortunate victim, as its face was drawn in, was a solemn wink, which seemed to say, "It's all right, my good Sir ; it will be worse for the snake than for me. I'll give him a horrible fit of indigestion !" The whole process occupied exactly two hours. How long the toad would live in the snake's inside it is impossible to say. Two naturalists, out on a collecting tour, captured a snake a little more than a yard long, which had a peculiar lump in the middle. Whilst carrying the snake homeward by the tail, they noticed that the lump gradually approached the head. They hung the reptile to a tree still with its head downwards, and awaited developments. The mouth slowly opened, and a large toad covered with a greenish slime dropped out. After some minutes the toad recovered, "and was seemingly little the worse for its imprisonment." SCIENCE GOSSIP, 1874, p. 68.

The snake is not always a conqueror, it is sometimes, as we have already seen, a victim. I have seen a pigeon-hawk (*Falco columbarius*) pounce down upon and fly off with a garter snake ; and, stranger still, I have seen a hen shake out a red-bellied snake (*Storeria occipitomaculata*, Baird and Girard,) as one would snap a whip, and then gobble it up—beating back her chickens with her wings meanwhile. The air of complacency, befitting one who had done a virtuous action, with which she afterwards strutted off with her brood, was a thing to be remembered.

Besides the snakes above-mentioned we have in the province of Quebec two others that are frequently met with—the riband snake and the water snake, and two which seem to be local and rare—the milk snake and the grass snake.

The milk snake (*Coronella eximiens*, De Kay) is found on the hills bordering upon Vermont. I have taken it on Shufelt's Hill which overlooks the village of Sweetsburg. It is an exceedingly beautiful creature. Its body-color is fawn, softening down to white underneath. All along the back and sides are irregular blotches of rich warm brown bordered with very dark brown.

The grass snake (*Cyclophis vernalis*, De Kay) I have met with only in the neighborhood of Quebec. Two years ago I found a dead specimen in the road near the English Church at New Liverpool ; and last summer I captured the living snake on the Island of Orleans. The circumstances of the capture were these : I had drawn down a branch of a young ash-tree to examine it for larvæ, and I was conscious of the fall of a rather heavy body. I glanced down, and at my feet was the snake just making off. I took it with my net, and examined it closely. It was about one foot eight inches long. In form it was very elegant ; and its color was a delicate pea-green, without spots or markings of any sort. Underneath the hue was somewhat paler, much like that of the down on the body of the Luna moth. The eye of the snake was black, and its glance was as mild and innocent as that of a canary bird. While I was debating in my mind how I should carry it home—for I had no box with me large enough to hold it—it found a hole in the bottom of my net, escaped through it, and glided into a clump of young thorn-bushes and I saw it again no more. It frequents the trees to catch young birds and insects.

But it is when we come to interview the insect tribes that we find the most astounding series of gastronomical accommodations. One insect fattened upon another is destined to become food for a third, which in turn must fall a prey to a fourth. Consider the

SPIDERS.

We have been taught to look upon the spider as an embodiment of successful villany—of cold-blooded calculation. We hold in abhorrence its stealthy steps to entrap the innocent and unwary.

> "Will you walk into my parlor?
> Said the spider to the fly;
> 'Tis the prettiest little parlor
> That ever you did spy;
> You only have to pop your head
> Just inside of the door,
> And you'll see so many curious things
> You never saw before."

Oh, the old reprobate! How much satisfaction it affords us to think that the black-headed Tit (*Parus atricapellus*) and other birds snap up without hesitation this betrayer of the innocent. But birds are not the only avengers upon its footsteps. Numerous insects make it their prey. Even that monster spider *Mygale Hentzii* (Fig. 32) of California finds a Nemesis in the "Tarantula Killer," as it is called, the *Pompilus formosus* of Say. (See the "American Entomologist," Vol. I, p. 129).

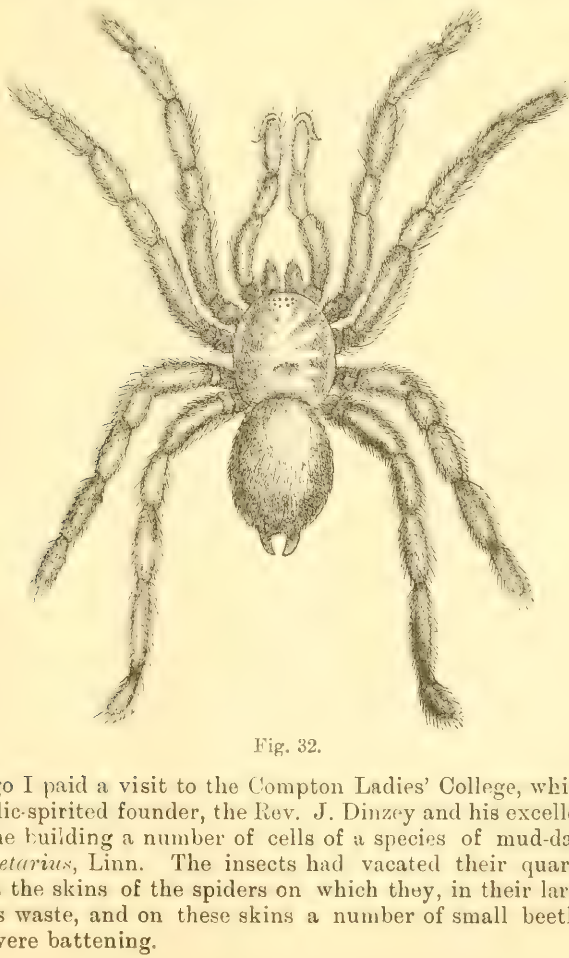

Fig. 32.

Some years ago I paid a visit to the Compton Ladies' College, which was then under the care of its public-spirited founder, the Rev. J. Dinzey and his excellent wife. I found in the cupola of the building a number of cells of a species of mud-daubing wasp, probably *Pelopœus cemetarius*, Linn. The insects had vacated their quarters, but there remained in the cells the skins of the spiders on which they, in their larval stage, had fed. Now nature abhors waste, and on these skins a number of small beetles of the species *Ptinus fur* Linn, were battening.

The mother mud wasp after building a cell crammed into it a number of spiders which she had paralyzed with her sting. Having provisioned her nest she laid an egg in it. The business of the larva that hatched from this egg was simply to make a long feast on the fresh food stored up for its use. But Walsh tells us that the larva is not in every case left undisturbed in this pleasing occupation. An ichneumon-fly (*Cryptus junceus*, Cress) sometimes pierces the wall of a cell and ejects an egg, the larva from which proceeds to dispose of the rightful occupant. Commenting upon this Walsh says: "Thus the spider preys upon flies, the mud-dauber upon the spider, and the ichneumon-fly upon the mud-dauber. 'Kill and be killed; eat and be eaten." This is the great universal law of nature." "American Entomologist," Vol. 1, p. 137.

I do not like to dismiss our friend *Ptinus fur* without further notice. He is small but he likes high living. He is a fellow of wonderful appetite! I think he outdoes in that respect the famous ostrich which indulged in ten-penny nails and broken bottles, or the African chief who despoiled a party of travellers of their supplies and was seen to eat up a pot of blister salve. It affects the dried specimens in our cabinets seasoned with oxalic acid and verdigris. Curtis found it eating an old coat; and it has been known to thrive on such gentle stimulants as *Nux vomica* and capsicums.

Not only are spiders exposed to dangers from without,—sometimes they suffer from "terrors within." The hair-snakes have been known to make use of them as hosts.

HAIR-SNAKES

are plentiful in the Province of Quebec. The most common of them is *Gordius varius*.

The Rev. E. A. W. King, of Waterville, obtained a worm ot this species, and placed it in a dish of water, that he might observe its motions. In a short time it commenced to lay its eggs. They were in the form of a white thread, many inches long, which was gathered into a loose tangle, and through and about which the worm entwined itself, as if to hold it in safety. He did not wait for the eggs to separate and hatch, but consigned the string and the mother worm to a bottle of alcohol.

I have obtained a male *Gordius* from a larva of *Zaræa Americana*, and a White Hair-snake 10 inches long from a Lepidopterous larva, that in length, was but an inch and a quarter. The creature lay closely curled—like the spring of a bird-trap—under the skin of its victim.

Hair-snakes are often met with in strange places. A lady in Montreal, feeling thirsty in the night, took a glass and filled it from a tap in the bath-room. While drinking she felt a tingling sensation on her lip. She paused—struck a light—and to her disgust found one of these creatures in the tumbler. (Moral: Look before you drink).

I lately heard an advanced version of the old myth of the horse-hair in the water. A gentlemen accompanied a hunter on an excursion in search of moose. The hunter looked carefully into every stream they came to, and, at length, discovering Gordii, exclaimed joyfully, "Yes, moose have been here—here are hairs from them turned into snakes."

The history of the hair-snake is not yet completed. The adult worm—its form and structure—its nervous, muscular and reproductive systems, have been fully described. Its mouth is said to open upon a gullet which spreads out upon the upper end of the cellular tissue which extends through the whole length of the worm (Dr. Meissner, quoted by Dr. Leidy, "American Entomologist," Vol. II, p. 195.) Its food, which has (it should be remembered) already gone through the digestive organs of its host, is passed "by endosmosis from cell to cell" and is completely assimilated.

The eggs, the embryos, and the newly developed Gordii have all been described. The last have been seen to enter the bodies of the larvæ of Ephemera, and have been found in them *encysted*. But, between the notice of them in that condition and the record of the perfect worm, there is a gap in the history. It remains for some careful Helminthologist to fill up the hiatus. It is believed that the Gordius is one of those creatures that have to pass from one host to another (like the Trichinæ) before they can

reach their perfect state. We can understand how it could pass in the May-fly to predacious insects, such as the spider and the ground-beetle, but not so readily how it could find a second host in a a vegetable devourer, such as the locust or the caterpillar. It may be that the encysted worm is cast off with the pseud-imago skin of the fly, or that it survives the decay of the fly itself, and, being caught in the herbage, is taken in by some hungry herbivorous insect. The chances against it, in this case, seem to be very great. Still, when we remember the vast number of eggs laid by one female Gordius—they have been estimated at more than six millions and a half—we must allow that there is a very broad margin for failures ; and that if only a small percentage of the brood arrives at perfection, there must be a very great number, indeed, of hair-snakes that run the full length of days allotted to their kind. In the case of the tape-worm, *Tænia solium*, we know that the ova survive the decomposition of the ejected proglottides or divisions of the worm, and are swallowed by hogs and sheep as they feed upon the vegetation.

Another kind of creatures that affords us much food for reflection is the

Aphides.

One day in July of this year I found two patches of these "plant-lice" on the broad Windsor beans growing in my garden. My first impulse was to destroy the intruding insects, but entomological curiosity overcame horticultural prudence, and I made up my mind to allow the insects to run their course. By the end of August there was not a stalk in the double row of beans (which was 12 yards long) that was not black with aphides. The insects clustered especially on the topmost leaves, and among the flowers, and along the edges of the pods. The winged brood of the species appeared in the middle of September.

The number of familiars and foes that resorted to this colony of aphides was truly amazing. First there were the ants busy about their "milch cows"—as the old naturalists called them. It was amusing to see a cunning ant approach an aphis and caress her daintily till she—either indignant at the liberties taken with her, or tickled to death with the fun—ejected the precious drops that the ant was longing for—for the love of the ant for the Aphis is simply cupboard love.

At least four kinds of lady-birds employed themselves in lessening the numbers of the aphides :—The Thirteen spotted, Fig 33, (*Hippodamia tredecim-punctata* Linn,) the nine-spotted, Fig. 34, the beetle, fig. 35 larva, (*Cocinella novem notata*, Kirby,) the five

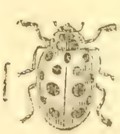

Fig. 33.

Fig. 34.

Fig. 35.

Fig. 36.

spotted, fig. 36, (much magnified,) (*C. quinque-notata*, Kirby,) and the two-spotted, (*Adalia bipunctata*, Linn.) The handsome larvæ of these species might be seen driving their snouts into the ill-fated aphides, and after a while casting them off "flaccid and drained." The coccinellidæ are among the gardener's most useful insect friends, but they are not always duly appreciated. A gentleman saw a gardener busily employed in picking off the Lady-birds from his plants and treading them under foot. "What are you doing that for?" he asked. "Well, sir," was the reply, "you see these nasty red things—them's the old uns ; you see these little green things—them's the young uns just hatched. I'm killing the old uns fust, and I'll tackle the young uns arterwards."

Attracted, by the aphides, and the honey-dew which they ejected, innumerable two-winged flies buzzed daily about my beans. On one occasion I counted fifteen different sorts. Conspicuous amongst them were, *Eristalis tenax*, Linn, the Drone Fly (so called from its resemblance to the male of the honey bee); a pretty black and yellow Syrphus Fly, *Eristalis transversus*, Wiedeman; *Volucella erecta*, Walker, easily distinguished by the brown patch in its wings; *Tachina vivida*, Harris, a bustling showy insect with a large orange-red abdomen set with black bristles; the Flesh Fly, *Sarcophaga*

Fig. 37.

carnaria Linn, Fig. 37, (highly magnified,) large, red-eyed, with striped thorax and mottled abdomen—grey and black; the Green-bottle Fly, *Musca Cæsar*, Linn; the Blue-bottle Fly. *M. vomitoria* Linn, and a species of *Scatophaga*.

Less abundant as regards individuals, but more numerous in point of species were the Hymenopterous insects that frequented that row of beans. The following is a list of twenty different kinds of them captured during the month of September with the cyanide bottle only:

Ædynerus tigris, Saussure.
Philanthus bilunatus, Say.
Crabro singularis, Pack.
Monedula ventralis, Say.
Aphilanthrops frigidus, Smith.
Pompilus atrox, Dahlbom.
Hedychrum violaceum, Lepell.
Ichneumon comes, Cresson.
I. lætus, Brulle.
I. flavizonatus, Cress.
I. jucundus, Brulle.
I. creperus, Cress.
I. paratus, Say.
Trogus Copei, Cress.
Amblyteles indistinctus, Prov.
Opion purgatum, Say.
Opheletes glaucopterus, Linn.
Bassus leatatorius, Fab.
Pimpla pedalis, Cress.
Sampronota Americana. Cress.

A few words on

INTERNAL PARASITES.

The lowest types of these with which we are acquainted are the Gregarinidæ which are found in earth worms and other annulids. The gregarina of the earth-worm consists of a transparent capsule filled with a colorless, semi-fluid, granulated mass, in one part of which a well-defined nucleus appears. The creature has no digestive apparatus—it lives by absorption of fluids through the capsule. When two

Gregarinæ meet they adhere one to the other, and then surround themselves with a cyst. The partition between them disappears; the nuclei also disappear and then the case becomes filled with spindle-shaped bodies called "pseudonavicellæ," which in due time escape from the cyst into the surrounding medium. Their after history is not yet told.

It is said that when a gregarina finds itself left in a state of single blessedness it does not give itself over to despair, but proceeds to encyst itself, and to produce pseudo-navicellæ on its own account.

The internal insect-parasites of insects are of two kinds: (1) Those that complete their metamorphoses within their victims; and (2) Those that leave their hosts on the completion of the larval stage.

Of the former, *Rhogus intermedius*, Cress, affords us an example. It assails the larvæ of *Apatela hastulifera* Abbot and Smith, which feeds upon the alder *Aldus incana*, Willdenow.

The parasitized Apatela larva may be found in the autumn attached to the leaves and stems of the plant. In them the ichneumon grubs, having attained their growth, form their thin, brown, closely-woven cocoons, which are arranged at an angle of about forty-five degrees, and usually in four rows. I have drawn out with a setting-needle no less than thirty-five pupæ from one caterpillar. They were all placed with the head upward. Very regular rows of round holes show how the adult ichneumons escape from their nurseries. As I have found the flies at large in the middle of October I presume that some of them, at any rate, pass the winter in the perfect state.

There are much larger insects that undergo all their changes within their hosts such as *Ophion macrurum*, Linn, Fig 38, in the Saturniadæ, *Opheletes glaucopterus*, Linn, in Cimbex. The eggs of these are laid singly or in pairs.

Fig. 38.

Fig. 39.

Of parasites that leave their hosts when full fed and before undergoing the pupal change *Apanteles longicornus*, Prov, is an example. The fluffy, yellow masses of the cocoons of this species may often be seen attached to the remains of noctuid larvæ, under the rails of fences, etc.

What entomological neophyte has not experienced the disappointment of finding, on a sudden, a carefully tended Sphinx caterpillar in a state of collapse, and bristling with the larvæ of some microgaster, that have extruded themselves from it, and that proceed to spin their cocoons about its remains.

But surely the most economical of all the internal insect parasites is the well-known *Cryptus extrematus*, Cress. The larvæ of this insect find themselves, they know not how, in the inside of a caterpillar of *Platysamia Cecropia*, Linn, and forthwith commence the herculean task of reversing the state of things in which they find themselves, and of environing their environment—putting the outside grub into their insides—beginning with the fatty portions of it. Numbers and perseverance accomplish the task, but not

before the caterpillar has spun its wonderful cocoon. When this is finished the Cryptus larvæ, finding no more fat in preparation, hold a grand carnival on the vitals and frame of their host, and then spin their own cocoons within the snug winter quarters prepared by their unhappy victim. In them they lie through the winter as snugly packed, Fig. 39, as herrings in a barrel or sardines in a box.

Cannibals.

Among insect feeders upon insects the "Cannibals" must not be passed by. Of English caterpillars that have a bad reputation as such, *Thyatira derasa*, *Characlea Delphinii* and *Cosmia trapezina* are well-known examples. With *Mantis Carolina* Linn, the nuptial embrace has been known to end in the death grip, and the female to make a wedding breakfast of her spouse.

But the most startling story of all was told by J. F. Stephens, author of "Illustrations of British Entomology." He said that having turned the tail of a dragon-fly round to the head he saw the insect make a meal of four joints of its own abdomen. (See *Ent. Mag.* 1., p. 518). If this story had not come from so good a source, we should have thought it of like kind to that told of the Irishman, who, having disturbed a mud-turtle, "saw the baste swallow its own head."

There remains one other sort of devourers of insects that I wish to notice before concluding my paper—it is


Fig. 40.

Fungi.

We are accustomed to the idea of insects feeding upon vegetables, but that of vegetables feeding upon insects is not so familiar to us.

A fungus that has excited much interest amongst naturalists is the *Sphæria Robertsiana*, which grows in, and out from, the caterpillar of a New Zealand Ghost-moth, *Hepialus virescens*. This caterpillar undergoes its pupal change in the soil. But it often happens that a spore from the Sphœria finds a lodgment upon the body of a Hepialus caterpillar—usually between the head and the segment following—and, vegetating there, penetrates to the creature's inside. The animal contents of the caterpillar are by degrees exhausted by the fungus, and the skin—which retains its perfect form—becomes filled with vegetable tissues. At the same time one or more sprouts from the fungus rise through the soil, and into the open air. Fig 40. The sporules are formed round the top of this shoot, which is sometimes ten inches long. The parasitized larva is called by the Maories "Hotete." It is sought for by them and greedily eaten. It is said to have a nutty taste.

There is a fungus of somewhat similar habits that affects the larvæ of the May-beetle, *Lachnosterna fusca*, Fröhl. It is found at Quebec.

In my paper entitled "A Day in the Woods," published in the Society's twenty-first Report, I told of a fungus *Entomophtora grylli* var. *aulica*, Fres, that was destroying the caterpillars of Arctians of different kinds. This fungus is still destructive. It affects particularly the larvæ of *Leucarctia Acrœa* Drury and *Spilosōma Virginica*, Fabr.

It may be that our meadows have been preserved from depredations, such as those described by Harris, under the head of "The Salt Marsh Caterpillar,"—("Insects Injurious to Vegetation," p. 351), by the agency of this fungus.

Time would fail to do justice to my theme—a volume might be written on every division of it; but I trust that I have said enough to awaken interest, and to stimulate research.

AN ATTACK OF EPHESTIA INTERPUNCTELLA.

BY H. A. STEVENSON, LONDON.

Attack.—Slender white or pinkish cylindrical caterpillars from one-half to three-quarter inches in length, with reddish-brown heads; a dark brown stripe runs along the side. The caterpillars were found feeding on raisins, prunes, rice, currants, dried apples, and wherever found they could be traced by whitish silk threads or webs. The caterpillars, when full-grown, spin close whitish or greyish-white cocoons about a half-inch long and one-sixteenth of an inch in diameter. When the caterpillars emerge from the cocoons they are a narrow rolled-up-like moth, and are a brownish-grey color with a golden lustre. A more complete report of this insect is contained on page 77 of Mr. Fletcher's report in the Experimental Farm Reports for the year 1889.

On August 17th I was called to a wholesale warehouse in this city (London), where they said they were troubled for the last three days with a small moth, which was increasing very rapidly. When I went down there these small moths were flying all over the warehouse in great abundance, from the cellar to attic; they were even on the outside of the front door, and they had originally started at the back door. I asked them where they came from, and they replied that they did not know where they came from, as the first were observed only three days before, so, after looking over the place I came across a shipment of Sultana raisins behind the back door and alongside the elevator. There were about 500 boxes, and the boxes were almost covered with the caterpillars and the moths. The moths were flying about in great abundance. A great number of the caterpillars had fallen down the elevator into the cellar, and some had also climbed up the supports of the elevator into the upper stories. The caterpillars had also penetrated into the adjoining rooms, and were swarming over the tea chests in great numbers—in fact, were into everything.

The raisins had been imported from Smyrna by Liverpool and Montreal, on October 20th, 1893, and had remained in the warehouse since then.

In three days from the time they were first noticed they had swarmed all over the warehouse.

Remedies.—I recommended that the raisins and the tea chests, which were swarming with the caterpillars and moths should be placed in some large boxes which were air-tight, and in which some bisulphide of carbon had been exposed in open dishes and left for a time. The moths and caterpillars on the tea chests soon fell off, as they had not penetrated into the interior. But the raisins were left over night in the boxes and the pests were soon destroyed. The firm tried spraying the place with the bisulphide, but it dissolved all the rubber atomizers used.

At night some bisulphide of carbon was exposed through the different parts of the warehouse, and the proprietor collected the keys from the different employees and cautioned them about the use of lights, as the bisulphide of carbon is very inflammable, and the whole warehouse was swept thoroughly through with a good stiff broom.

The raisins were unpacked and picked over and thoroughly cleaned and reboxed again as good as new. I have been in the warehouse several times since, and have not noticed the recurrence of the insect.

Thanks are due to Mr. Moffat, who at once identified the insect and compared it with the specimens in the Society's collection. And thanks are also due to Mr. J. Fletcher, of Ottawa, to whom specimens were sent, which he identified as Ephestia interpunctella, and also for his immediate reply concerning the destruction of the pest

THE ECONOMIC VALUE OF PARASITISM.

By F. M. Webster.

In the term parasitism, as here used, is included the preying of one organism upon another, whereby the latter is largely kept within normal, numerical bounds, or is reduced to such conditions when it rises beyond them. Or, in other words, the preying of certain so-called beneficial insects upon others called destructive, and the action of fungoid growths upon such destructive species. Parasitism, in its broadest sense, has been aptly termed the balance wheel of nature, because of its similarity in effect to the mechanical contrivance bearing that name, which is instrumental in equalizing the irregularities of motion, in the machinery of which it is a part, and hence dependant upon the same source for its motive power.

The effect of vegetable devouring insects is to prevent the encroaching of one vegetable upon another, lest the latter should be exterminated: and the insect and fungoid enemies of such vegetable-feeding insects prey upon them in order that they do not themselves carry their work to such an extent as to exterminate the plant they are only designed to restrict. Thus we have a plant being fed upon by a species of insect, which insect is being kept from exterminating this plant by its own or primary parasites, and these in turn are kept from destroying all of the plant-feeding insects by still other parasites, known as secondary parasites, and these also have their parasites, known as tertiary parasites, and besides are more or less influenced by meteorological environment. To make the matter still clearer, it is as if a number of men were sent to prune an orchard, and a superintendent sent with them to see that the task was not over-done, he too, being amenable to still other authority.

Now, both plants and insects are capable of reproducing far beyond the number of young ordinarily required to keep these elements in equilibrium; but when, from any cause, one of them becomes abnormally reduced, this reserve reproductive force is brought into play, and the weakened element is thus soon able to regain its normal numerical power, but is restrained from going beyond. We thus have a huge piece of natural mechanism, self-regulating and self-adjusting, the balance wheel of which is parasitism.

Under perfectly natural conditions and uninfluenced by man, all of these natural organisms work in unison, as above indicated, and a temporary disarrangement of any one element, due to outside causes, such as the weather, is soon readjusted with little more disturbance to the others than would result to the Gulf of Mexico from the dropping of a pebble into the middle of the Atlantic ocean. In some cases a few plants might be killed throughout the local areas, but these would soon be replaced by others. But the husbandman now appears and upsets this equilibrium by destroying hundreds of species of plants over an area of millions of acres, and in their stead replacing but one. He causes a thousand apple trees to grow where nature intended but ten should exist. He causes the ground to produce a thousand grain plants, where nature intended but one to grow, and to produce seed far in excess of nature's requirements. The result is that the insect enemies of these cultivated plants, or such insects as can feed upon them, are greatly increased in numbers, because more of the young find a sufficient amount of food to develop them, and because they are needed by nature to counteract the influence of man. Later, the parasites, both primary, secondary and tertiary, increase for precisely similar reasons, and in obedience to the same laws, though, of course, they follow more or less distantly the movements of their hosts. From the fact that their movements do follow more or less distantly the ebb and flow of their respective hosts, the question of the economic importance of their influence has remained unsettled, and, by some, has even been doubted. When we come to consider that but an exceedingly small percentage of the movements of these insects ever reaches the eyes of even the most observing entomologist, and of the interactions of these organisms we really know but very little, it will be observed that to estimate the economic value of their influences is a very difficult task, if one expects to be just and secure the actual facts. A millionaire, in one of our larger cities, may replenish his purse at the bank each morning and go about among the poor, supplying to the needy a coat here, a pair of shoes there, a break-

fast in one place and a supper in another; medicine for one sick mortal and medical attention for another; and go on in this way for years without being known outside of his own city, especially if he does not choose to advertise his generosity. But let him once fall into the clutches of a dissolute woman whom he may have, out of pity, befriended, and he will be publicly introduced from one side of the continent to the other, and the student of human nature will, indeed, have to be exceedingly guarded in his conclusions if he expects to get an unbiased estimate of this man's character, based only on the facts thus placed in his possession. Yet it seems to me that he is in as proper position to do so, as is even the working entomologist to pass upon the value of parasites in overcoming an invasion before more or less financial loss has accrued, basing his judgment upon the failures to do so that have come under his observation, and necessarily leaving what he does not see out of consideration. I do not believe anyone, be he ever so good an observer, can, within the space of one life time, collect data sufficient upon which to base the statement that "they usually appear in force only after the damage is done." Twenty years of close observation of insects, in the fields, leads me to make this statement; and I venture to say that in ninety-nine cases out of one hundred, an invasion of an injurious insect will attract the attention of an ordinary entomologist only when its parasites fail to overcome it before it has caused monetary loss. If the entomologist does not see them, how much more likely is the ordinary farmer to note these conflicts between parasites and hosts! It is the failures that usually first attract our attention, while the successes are more often unobserved, and, such being the case, how can we, with justice, weigh evidence we do not possess, and of the magnitude of which we can have little conception.

Now, I will give a few personal observations relative to this matter, which illustrate the fact that thousands of similar cases might pass unnoticed, even by those possessing fair abilities for seeing such things.

Ten years ago, in Indiana, I was studying wheat insects, and found the Wheat Midge larvæ, *Diplosis tritici*, exceedingly abundant in a number of fields; enough so to threaten serious injury to the crop. Soon after I observed these, considerable numbers of *Coccinellidæ* and *Telephoridæ* were running about over the heads of the wheat, thrusting their own heads down among the bracts, and feeding among the maggots of the *Diplosis*. Some of the *Telephoridæ* were venturesome enough to thrust their heads among the bracts in order to secure such of their prey as were exposed by the bending of the head as it swayed in the wind and were caught by the wheat head suddenly returning to an upright position, and if a breeze did not soon release them, paid the penalty of their temerity with their lives. Thousand of these carnivorous beetles were present, and they must have destroyed millions of the *Diplosis* larvæ, in the ten days to two weeks they were observed at work, and no perceivable injury resulted from the invasion of the midge.

A few years later a couple of coniferous trees on the campus of a western University were attacked by a scale insect, *Mytilaspis pinifoliæ*, if I recollect correctly, and by midsummer the leaves had a decidedly whitish tinge, as if sprayed with a dilute whitewash, and besides, took on a sickly look. In the meantime a colony of *Chilocorus bivulnerus*, or Twice Stabbed Lady Beetles, (Fig. 41), as they are commonly called, took up their abode on the trees, deposited their eggs and with the larvæ from these (Fig. 42) began to destroy the scales. All through the autumn the contest was waged, and with the coming of cold weather all the beetles, which had long before escaped from their pupa cases, went into winter quarters. With the coming of spring they were observed to return to the trees, and again began the contest in turn giving way to their larvæ, and these emerging as adults. In early summer the ends of the branches began to show leaves free from scales, and by the coming of winter again the outbreak of the pest had apparently been entirely overcome, and the fall rains washed off all vestige of the conquered hosts. The invasion had been overcome, and I doubt if another person besides myself had been aware of the two years' conflict.

Later, the maples along one of the principal residence avenues of Columbus, Ohio, were threatened with an invasion of the Maple Bark Louse, *Pulvinaria innumerabilis*, (Fig. 43), and the trees would certainly have been overrun the following year, had not this same Lady Beetle appeared in numbers, and with their larvæ so reduced the pest in numbers as to render injury impossible.

The appearance of the Grain Aphis, *Siphonophora avenæ*, in such enormous numbers, during some seasons and the almost total absence of them during others, are matters of continued observation, but the causes therefor are not well understood. The present season, there was, quite early, indication of an outbreak of this species, but later it largely disappeared, while the cause for its doing so is obscure. Now, with all the light on the subject that I have been able to gain from several years' study of this insect, I am about convinced that the secret lies in the condition of the weather during spring; that

Fig. 41.

Fig. 42.

Fig. 43

cold, wet weather, at that season retards the development of their Hymenopterous parasites, by which they are largely held in check, but does not retard their own development to the same extent, thus giving them an advantage, early in the season, which is sometimes not overcome until much later and after the aphis has worked some injury. One other observation and I am done, though if space would allow, and time permitted me to go over my note books, I could multiply the number by at least fifty.

Late in April and early in May of the present year, there was considerable consternation among the farmers over a large portion of the State of Ohio, caused by the appearance of enormous numbers of the larvæ of the Clover Leaf Weevil, *Phytonomus punctatus*, in the clover fields. These larvæ were literally swarming and eating the plants to the ground, which, together with the drouth prevailing at the time over the northern portion of the State, gave matters anything but a favorable appearance, and it seemed that many fields could not escape ruin. In fact, an occasional farmer was frightened into plowing up his fields. But just here a fungous disease, *Entomophthora sphærosperma*, Fresn., appeared and the effect was astounding. Farmers who had about given up all hope of a hay crop, wrote to say that the worms were all dead or dying and they could not find a live one. One farmer, who came in to consult me about breaking up his field, came a few days later to say that all the worms were dead or dying, and I found a close search was necessary to fine a healthy one of any size, and but few of even the youngest. Now, I do not believe a million dollars would cover the saving to the hay crop of Ohio, by this minute fungus, the present year. But this is not all. Soon after, rains occurred and the effect of the worms resulted only in retarding the blooming of the clover, precisely the effect of mowing or pasturing when done to prevent the depredations of the Clover-seed Midge, *Cecidomyia leguminicola*, and whether the result was the same or not, the farmers over the area covered by this Leaf Weevil, harvested a good crop of clover seed.

As previously stated, I do not even pretend to have observed a one-thousandth part of similar instances that have been going on in every locality each year. And I repeat again, it is the cases where parasites fail to overcome a destructive insect, before it occasions financial loss, that are the exceptional ones, and the nature of these failures is such that we see and recognize them far more readily then where the reverse is the case. It is the damage that we see, and this being the case, how can we see it before it exists? Not only this, but I believe the great fundamental principle involved in the use of insecticides is to assist parasites in doing their work; and as we get to applying them more and more intelligently, we shall watch for the exceptional cases where parasites are weak in numbers, and by artificial methods, seek to offer a substitute for the lack of numerical strength.

A RE-APPEARANCE OF PIERIS PROTODICE BOISD.

By J. Alston Moffat, London, Ont.

On the 18th day of October, 1894, I received a *P. protodice* from Mr. C. Anderson, a young collector of London, who has done some excellent work during the past summer, by sugaring in his father's garden. A few days previously he had called on me to say that he had seen on the street a white butterfly that was new to him. Failing to recognize his description of it, I showed him the drawer containing the *Pieris*, when he at once pointed to the female of *protodice* (see fig. 15) as like what he had seen. I gave him some information about the peculiar history of that butterfly which excited his interest, and he determined to make an effort to obtain some of them. With that end in view, he went on the 17th to a locality which he thought was the one most likely for them to be found in, with the result that he secured a pair of them, and when he showed them to me on the 18th they were yet alive. This is the first living pair of that butterfly that I have seen since the autumn of 1872, when *Pieris rapae*, the imported cabbage butterfly appeared on the stage to act its part, whilst the native one retired from view.

In 1887, Mr. S. H. Scudder, of Boston, published a most interesting account of the introduction and spread of *Pieris rapæ* from 1860, the year in which Mr. Couper captured a few specimens at Quebec, where it is supposed to have been landed, and the first reported to have been seen on this continent, to 1886, when it had reached the Rocky Mountains. This history of the introduction and spread of *P. rapæ* is full of interest and importance to the cultivators of some of the most valuable products of the field and garden; but the fact, that as the imported *rapae* advanced the native *protodice* disappeared, has ever seemed to me to be one of the most singular and interesting events in natural history that has come under my observation.

I have seen the statement made by various writers, that *Pieris oleracea*, also native, has disappeared from their locality on the advent of *rapæ*. This does not accord with my experience. *Oleracea* I always found to be confined to certain locations, periodical in its appearance and never very plentiful; and so it has continued to be. But *protodice* used to be more or less abundant every autumn until *rapæ* came, when it totally disappeared from my field of observation.

Mr. Scudder in tracing *rapæ's* gradual spread westward, says: "In 1873, as before stated, it reached Port Hope, and 'F. C. L.' reports taking his first specimen at Dunn in Haldimand county, Ontario, (Can. Ent. vi. 60), and some were taken at Hamilton (J. A. Moffat), where one would have looked for it the preceding year from its presence then at Toronto."

I have always felt quite certain that *rapæ* was present at Hamilton during the fall of 1872, although I did not notice it. My attention was arrested that season by the unusual abundance of cabbage butterflies, which I set down without examination as

protodice. Not being informed about the advance of *rapæ*, I did not suspect its presence until the following winter, when upon a visit to Dundas I saw specimens of it in Mr. Kyle's collection which he had captured in his own garden the previous summer without suspecting that they were other than a variation of the native *protodice.* So that if I had examined closely, I have not the slightest doubt but I would have found *rapæ* helping to swell the numbers that so attracted my attention during the autumn collecting ; confirming Mr. Scudder's expectations. Moreover, I found *rapæ* in the spring of 1873, indicating that it must have been present the previous fall. From that onward, I saw no more *protodice*, their place being taken by *rapæ.* And this I believe corresponds with the experience of Canadian collectors.

I have never seen this sudden and total disappearance of *Pieris protodice* satisfactorily accounted for. When I have seen the subject touched upon, it has usually been dismissed with a reference to "the struggle for existence and the survival of the fittest," which does not seem to me to apply in this case at all. The breeding habits of the two differ considerably ; the native *protodice* was quite content to make use of the natural products of the soil for its purpose, whilst the imported *rapæ* attacks first, and in preference to all others the cultivated ones. So there need have been no "struggle" between the two on that point, as there was plenty for both, and as the larvæ of *rapæ* had an abundance of vegetable food to its liking, it would not devour that of the other even if it had met with it on the same plant. As that theory does not account for the disappearance of *protodice*, I have to look for one that will meet the requirements of the case.

It is a well-known principle in biology, that there are races of animals of the same species, that are possessed of different constitutions and dispositions, and that there are in nature, external influences at work which, acting upon the living organism will produce such differences. That in some instances, such differences manifest themselves geographically, and are spoken of as geologic and climatic, or as pertaining to the soil and climate. That races may differ in strength of constitution and character according to the part of the globe to which they belong. And that a strong race commingling with a feeble one, will impress its peculiarities upon the results of such a union and make its controlling power manifest.

Now it is generally admitted, that the life of Europe is of a more vigorous, tenacious and aggressive character than that indigenous to this continent ; therefore I come to the conclusion that *protodice* and *rapæ* are but different races of the one species, and that when they met and commingled, the stronger constitution and proclivities of *rapæ* prevailed, and the outcome of the union were all stamped unmistakably *rapæ*, the characteristics of *protodice* being completely absorbed and obliterated. This seems to me to be quite sufficient to satisfactorily account for all that has occurred in connection with these two butterflies, and if it is correct then the probabality amounts almost to a certainty, that, sooner or later *protodice* will return. This is not a prophecy, but a simple deduction from the well-known laws of nature ; for the external influences that produced the typical *protodice* and brought it into harmony with its environment at first are still at work, and working in the same direction. Therefore, when these external influences have had sufficient time to work their utmost upon *rapæ*, and no fresh importations take place, a reversion to the original type will be brought about as a matter of course.

In seasons of its greatest abundance, *protodice* never caused any serious injury to cabbage, in this northern portion of the continent at least. Its larva was quite content to feed upon the loose outside leaves of the plants, and so did but little harm ; but the larvæ of *rapæ* will eat their way into the solid heart of the largest heads, injuring them greatly, if not ruining them utterly. If then *protodice* should return with its original disposition unimpaired and supplant *rapæ*, it will be a welcome transformation to the cultivators of that useful vegetable.

REMARKS ON THE STRUCTURE OF THE UNDEVELOPED WINGS OF THE SATURNIIDÆ.

BY J. ALSTON MOFFAT.

I have had an opportunity of making further microscopical examination into the condition of the undeveloped wings of one of the large Saturniidæ.

During the winter of 1893 and 1894, I secured a large number of the cocoons of *Attacus promethea* and *Telea polyphemus.* In the early spring of 1894 I watched them closely, so as to secure, if possible, some of the moths on their escape from the cocoon, before expansion had commenced.

I was fortunate on being present at the moment of emergence of a fine large specimen of *T. polyphemus*, which I killed at once before growth had started. After removing the front winglet from its socket in the thorax, I found that the crimpling of the heavy nervures on the costal margin had relaxed, yet, even with that addition to its size, it measured only five-eighths of an inch in length and about three-eighths at its widest part; which might have expanded to three and a half inches in length, and one and a half at its widest part.

I did not discover anything new about the structure of the nervures, but I paid especial attention to them in relation to some suggestions that were made in connection with my former observations, to see how far they might be correct or otherwise.

One was, that the nervures might be constructed spirally, and that the extension of the membrane of the wing might be produced by, as it were, the relaxing of a compressed spring. I could see nothing to confirm such a view. The prominent rings of each segment made a complete circle. The extension of the nervure is in a straight line, something after the manner of the drawing out of a telescope, only, the one section not merely draws out of the other, but the small end of the one section draws out with it the inside of the large end, and keeps on extending until the nervure is all brought to a uniform thickness, with a slight reduction to the outer end.

It has been claimed by some, that the fluid enters the nervures and assists in the extension of the membrane. This, I am satisfied, is not the case. I examined the large nervures of an expanded wing, and found some parts of them hollow, and quite empty, which would not have been so if fluid had entered them. Moreover, the parts of the nervures where the segments unite seem to be solid, somewhat resembling the joints of a bamboo-cane, which would make the passing of the fluid through them almost, if not quite, impossible. My impression is, that the nervures do not in any measure contribute toward the extension of the wing, but depend for their own extension upon the pressure derived from the fluid flowing between the membranes.

The amount of fluid stored up in a newly emerged imago to be used in expanding the wing, must be very great. One of my *A. cecropia* in coming out of the cocoon, had in some way got a piece torn off a front winglet. Whilst expanding, fluid began to show at the break, and by the time the wing was fully extended, large drops hung all along the broken edge. This wing expanded as perfectly as the unbroken one; showing that there was enough fluid to do the work and some to spare.

I thought by maceration and manipulation to draw out the winglet to some extent; but was disappointed and not a little surprised to find that I could make little or no impression upon it in that direction. I afterwards thought that I discovered the reason of my failure.

I succeeded in cutting out a longitudinal section from between the heavy costal nervures of the winglet. Placing it on one of its cut edges under the microscope, I found that I had got a beautiful and intensely interesting object of contemplation. The gatherings of the membrane on the upper surface of the winglet, lay before me in a uniformly symmetrical row of elongated loops, with a row of tiny scales on the crest of each. The loops were nearly closed at their base, widest a little above their centre, making a narrow curve at their apex, open and quite empty. I looked for, and expected to find in the

membrane of the underside, loops or gatherings, corresponding in some measure to those of the upper side, but could see none or anything resembling them. The membrane appeared only roughened and wrinkled. It was extremely thin and very frail, and the base of the loops seemed to be attached to its inner surface. The thought occurred to me that this would account for my inability to draw out the membrane of the winglet, and will in a measure explain the reason for the comparative slowness of their expansion as compared with butterflies. That is, supposing the wings of butterflies are constructed upon a different principle; but this is a point which will require much more careful investigation than I have given to it.

The extent to which the fluid of the insect gives color to the scales is a very interesting subject for consideration. The fluid differs in color in different species. The color of the fluid decides the color of the membrane in the expanded wing; but to what extent it affects the color of the scales is not so easily determined.

Prof. V. L. Kellogg, in his able and interesting paper, "The Taxonomic Value of the Scales of the Lepidoptera," which appeared in the Kansas University Quarterly, for July, 1894, on page 49 says: "The scales are attached to the wings by means of their short pedicels fitting into minute pouches or cups on the surface of the wing membrane. . . . The cups sink but slightly into the wing-membrane, the outer open end being at the surface of the membrane, and the inner closed end or bottom of the pocket, being only slightly below the surface. . . . Thus the cups are more truly little pockets on the surface of the wing, than pits or cavities in it." On page 50 he says: "The pedicels of the scales are of slightly varying shapes and of different lengths, corresponding with the pockets into which they fit. Those which enter insertion-cups which are expanded at the base, or at some point between the base and the mouth, present at the tip or between the tip and the point of merging into the blade of the scale, respectively, a slight expansion, so that they are pretty firmly held in the cup by a sort of ball and socket attachment."

These quotations convey no intimation that there is any opening at the top of the scale, or that the tip passes through the inner surface of the membrane, whereby the fluid could enter the scales whilst flowing between the upper and under membranes of the wings. And yet I think we have positive proof that in some instances the fluid does enter the scales and influences to some extent their color.

When commencing his description of the structure of scales, the Professor, on page 51, says: "The scales are flattened sacs, composed of two membranes, enclosing sometimes only air, sometimes pigment granules attached to the inner face of one of the membranes, and sometimes (as observed in cabinet specimens) the dry remains of what may have been during life an internal pulp." Here in a foot note, Prof. Kellogg refers to Minot and Burgess, who, in their description of the anatomy of *Aletia*, declare that in all of the scales examined by them there was always an internal pulp which contained coloring matter. Then on page 69 Prof. Kellogg states that: "The colors of scales are produced by two causes: (1) The presence of pigment; (2) The overlapping, lamination and striation of the scales which produce those familiar but striking optical phenomena due to the interference of the waves of light. Combinations of these causes are usually present, so that the resulting color effects are practically incapable of analysis."

But there is a third cause of coloring. The long, slender scales on the winglets of a newly emerged *luna* are as pure a white as those upon the abdomen; when the wings are expanded these same scales are tinged with yellow. Whence did they obtain it? It is a well-known fact in the coloring of materials that a small quantity of green entering a pure white, a yellow is the natural result. Therefore the conclusion to me is irresistible, that a portion of the green fluid passing between the membranes of the expanding wings entered the scales—not enough to make them green, but sufficient to make them yellow. And there may be other lepidopterus insects which have the color of their scales modified in a similar way, but which will have to be detected by observing and comparing them in their unexpanded state with those on the expanded wing. The scales on an undeveloped wing are as much compressed, in proportion to their size, as the wing itself. As it

requires the action of the fluid to expand the wing, the natural inference is, that similar causes are required to produce similar results in the scale; but whether there is an opening in the scale corresponding to that at the base of the wing, to admit the fluid, or whether it enters by cell absorption, has yet to be demonstrated. In the great majority of cases the scales have their colors decided in the chrysalis, by internal pigments probably. What change takes place, if any, during expansion, I have not been able to ascertain, except a perceptible brightening of the colors.

After my paper was written I received from Mr. Balkwill a chrysalid of *D. archippus*, which had matured up to the point of emerging, then died before accomplishing it. I removed a winglet and proceeded to investigate. I failed to extend this winglet as completely as I did that of Polyphemus. It was much more elastic, and I could draw it out about half its own length, but it would go back again, and it was easier drawn out laterally than longitudinally. I found it impossible to remove the scales by any means at my disposal, and was becoming hopeless of seeing the structure of the membrane. I removed the costal nervure, and when examining the cut edge with a lens I perceived in one place that the edges of the membranes had parted. By many efforts and steady directing I succeeded in getting the point of a pin between them, when I found that the winglet was like an empty sac. The two membranes were not in the least attached; even at the edges there was no pressure required to separate them, and the only thing that showed any symptom of holding them together was the fringes; so I separated the two membranes clean from base to apex without an effort, when the whole structure of the winglet was exposed to view. The nervures are in the upper membrane, with a groove in the lower, opposite, into which they fit. Both membranes are structurally alike, but the gatherings are perceptibly finer in the lower as compared with the upper. The surface, under the microscope, presented the appearance of a multitude of light grey transverse lines with dark spaces between. The gray lines are the under edge of the gatherings, whilst the dark spaces are the openings into the loops, on the crest of which the scales are situated. The transverse lines are not solid lines, but seemed to be made up of minute elongated dots. Near the base of the winglet some of the lines had the appearance of being composed of wide-spread W's. Elsewhere the lines of the W's were erect and closely packed. This gives quite a different view of the wing structure from that obtained in my former observations of the upper surface of the membrane. Here we see all the material that is required for producing a wing two inches in length by one inch at its widest part, compressed into a space less than three-fourths of an inch long and three-eighths wide. We also see that there is nothing to prevent its rapid, or even instantaneous expansion when the fluid from the living insect enters between the membranes in sufficient quantity and force; but that is required for the purpose, and nothing else seems capable of producing the wing extension; but why the fluid does not escape at the edges I do not know, and yet all the butterflies that I have observed burst their chrysalis always let fall some drops of fluid, and it may be that this is whence they come, and which would also account for the general external moistness of the imago at that time.

But to return to a consideration of the moths. I am now convinced that there must be an actual growth of the lower membrane during the progress of their wing expansion. There is nothing in its structure resembling the gatherings observed in the lower membrane of this butterfly. There is an appearance of looseness in its texture, but it has none of the elasticity of the other; it would tear rather then yield. Then again, when small moths are expanding their wings, the edges invariably curl under, as if the upper surface was extending more rapidly than the lower, which no doubt is the case, and is the cause of the curling, and as they press the two upper surfaces together it assists in extending the lower membrane and straightens out the curls. Here the question arises, are the wings of all moths constructed on the same principle? And are those of butterflies all constructed upon the other? The further one travels along such a road the greater appears the distance to the end.

BORDEAUX MIXTURE AS A DETERRENT AGAINST FLEA BEETLES.

By L. R. Jones, Burlington, Vt.

Bordeaux mixture is a remarkable compound. After many comparative tests, experimenters have decided that no other mixture or solution yet discovered is equal to it as a general fungicide. Furthermore, those who have studied its action upon plants are agreed that it exerts upon them some beneficial influence entirely apart from its fungicidal effects.*

So far as I know, however, Bordeaux mixture has never before been experimentally shown to have value as a remedy against insects. Some experiments in this line made at the Vermont Experiment Station during 1893 and 1894 will therefore have so general an interest that I present the results before this Society.

Potato plants in Vermont suffer from the attacks of the cucumber flea beetle (*Crepidodera Cucumeris*, Harris). I cannot estimate the amount of the damage to the entire potato crop of the State from these insects, but I am convinced that it is most serious, especially during a dry summer, such as we have just experienced. In confirmation, I will pass around for your inspection, some leaves taken from our experimental potato plot at Burlington. You will perceive that many of them are completely riddled with the small holes eaten by these flea beetles. These leaves do not exaggerate the condition of the entire plants in many portions of our field. Leaves punctured and even skeletonized, as some of these are, suffer much from the loss of so considerable a portion of their leaf tissue. Moreover, leaves thus mutilated are most disastrously exposed to the effects of drouth during dry weather, and to the inroads of fungi and other parasites during wet weather. Indeed, these secondary injuries follow so closely after the attacks of the flea beetle, and the beetles themselves are so small and shy, that the great majority of potato growers attribute the entire trouble to these secondary agencies.

Entomologists have tried many remedies against these flea beetles. The one commonly recommended by them for use on potatoes is the standard insecticide, Paris green, mixed with land plaster and dusted upon the plants. As will be seen from our results below this poison has been of comparatively slight value with us. Certain fungicidal compounds, however, proved of decided worth in our experiments of 1893. These fungicides were originally applied to check the fungous diseases to which potatoes in Vermont are especially liable. Noticing that these sprayed rows were less badly eaten by the flea beetles, a careful count was made of the number of holes in fifty leaflets from each row of one plot under treatment. The results were as follows :†

In 50 leaflets sprayed with....	very weak Bordeaux mixture,	1,794	holes
" " " "	ammoniacal copper carbonate,	1,587	"
" " " "	modified eau celeste,	1,376	"
" " " "	weak Bordeaux mixture,	1,295	"
" " " "	strong Bordeaux mixture,	1,194	"
" " " "	strong Bordeaux mixture and soap,	945	"

These plants had been sprayed but once, August 1st. The examination was made August 12th. From our observations during the present summer (1894), we are convinced that most of the holes in the leaves sprayed with Bordeaux mixture had been made before the plants were sprayed at all, *i.e.*, before August 1st. The present season observations upon these insects were begun earlier. The beetles were first seen about June 1st. By June 12th some of our early potatoes were badly eaten. This attack lasted but a short time, however, and during the latter part of June and first two weeks of July but few beetles were seen. Suddenly, about July 20th, they again appeared in large numbers, and during the next ten days did great damage to unprotected potato plants. Previous to this time portions of our plants had been sprayed with various fungicides, and all the plants sprayed with the stronger copper compounds, especially with the Bordeaux mixture, have remained practically free from the flea beetle injuries up to date.

*U. S. Dept. Agric., Div. Veg. Path., Bul. 7, p. 31.

It has been unusually dry with us, and in consequence our field is free from fungus troubles, yet the contrast between the sprayed and unsprayed rows is most striking. On the unsprayed rows every leaflet has from 50 to 500 flea beetle punctures, the plants are pale and sickly, and are already beginning to shrivel from the drought. The rows sprayed with Bordeaux mixture are practically free from the flea beetle mutilations, vigorous and thrifty. I have brought for your examination two entire potato plants taken from adjoining rows, the one sprayed with Bordeaux mixture, the other not, which fairly represents these differences. A few days ago two leaves were taken from each hill of these two rows and carefully examined. An average of twelve flea beetle punctures per leaflet was found on the row sprayed with Bordeaux mixture. On the adjoining row which had received no Bordeaux mixture, but had been freely dusted with Paris green (1 pound Paris green in 50 pounds land plaster) there was an average of 262 holes per leaflet.

We therefore feel justified in advising the use of Bordeaux mixture on potatoes for a new purpose, namely : As a deterrent against flea beetles. The use of Bordeaux mixture as a fungicide has proved especially profitable with us during wet seasons. This newly discovered virtue will warrant its use during the dryest seasons also, since the flea beetles are most troublesome then. Judging from our experience this season, in Vermont two applications of the mixture will suffice to hold these beetles in check, and upon late potatoes one application will probably prove sufficient The first application should be made upon early potatoes during the first week of June, and another about July 15th This latter application is also well timed for the prevention of the fungus diseases of the potato. Upon later potatoes the earlier application just mentioned is not necessary. We may, therefore, say that practical immunity from flea beetle injuries to potatoes may be secured at the cost of but a single application of Bordeaux mixture in addition to those already recommended for the fungus diseases.

Regarding the value of other fungicides tested, modified Eau Celeste has proved nearly as effective a deterrent against these beetles as has Bordeaux mixture. All of the other copper solutions tested have had similar deterrent effects roughly in proportion to the amounts of copper contained. The inference, therefore, is that the copper salt is the element especially distasteful to the beetles. Soap, when mixed with these fungicides adds slightly to their value as deterrents, but not enough to justify its addition for general use.

THE GYPSY MOTH (*Ocneria dispar*, L.).

By James Fletcher, Ottawa.

Of the many injurious insects introduced at various times from the old world, not one has, in as short a time, attracted so much attention, been so great a cause of anxiety, or been so systematically fought as the Gypsy moth, since it appeared in vast numbers in the State of Massachusetts in 1889. As a practical object lesson of the value of scientifically directed effort to overcome an insect enemy which had been allowed to increase unnoticed until it had assumed almost overwhelming proportions, the campaign which has been so successfully carried on for the last four years by the Gypsy Moth Department of the State Board of Agriculture of Massachusetts is of very great interest to all economic entomologists.

Having recently passed through part of the infested region, my attention was attracted to the trees bearing bands of burlap or marked with the various signs used by the inspectors to denote that they had examined the trees. Since my return to Canada, I have been favoured with a full series of the excellent reports of the Commission, together with much other information as to the methods of work, which have been kindly furnished by Prof. E. H. Forbush, the director of field work. On the whole, I think all must acknowledge that, up to the present time, the efforts of the Commission have been very successful ; but whether the enemy is entirely exterminated must depend upon whether the work is continued in the same careful manner for at least a few years longer.

†For further details see Vt. Exp. Sta., Bul. 40, p. 25.

Mr. L. O. Howard, the United States Entomologist, one of the best qualified to express an opinion, says, in his recent address as President of the Association of Economic Entomologists, as follows: "The work upon the Gypsy moth which has been done by the State of Massachusetts since 1889, is one of the most remarkable pieces of work, judging by results, which has yet been done in Economic Entomology. The operations have been carried on by a Committee of the State Board of Agriculture, and the means have been furnished by large appropriations by the State Legislature. Three hundred and twenty-five thousand dollars have already been appropriated. A territory comprising something over 100 square miles was infested by the insects, which occurred in such extraordinary numbers as to destroy many trees, and almost to threaten the ultimate extinction of living vegetation, not only within the infested territory, but in all localities to which it might spread. . . . . The infested territory has been reduced by one-half, and within the districts in which the Gypsy moth at present exists, it is, practically speaking, a comparatively rare species. The future of the insect is, however, problematical. The continuance of sufficiently large appropriations from the State Legislature to enable the work to be carried on, on its present scale, is doubtful, and yet those in charge believe that still larger appropriations are necessary to bring about extermination. They are confident, however, that with sufficient means, the insect can be absolutely exterminated from the State of Massachusetts."

It will be instructive to consider how it was that this pest became so numerous before it was noticed, what measures were taken to control it, and lastly, what can be learned from the efforts of the Commission.

Prof. C. H. Fernald, the eminent Entomologist of the State, and Prof. Forbush have given, in the reports, most careful accounts of the introduction, habits and best methods of fighting this pest. There seems to be little doubt that the species was introduced into America in 1868, by a Mr. L. Trouvelot, then living near Glenwood, Medford, Mass., where he was carrying on experiments with various caterpillars as producers of silk. Having brought from Europe a cluster of the eggs of the Gypsy moth, he took them out of the box and laid them on the sill of an open window, whence they were blown away and lost. From this centre the moth scattered in every direction until, in 1891, it was found to have spread, during the twenty-three years, over thirty townships.

The chief causes of its increase are the prolificness of the females, the hardiness of the species, and the fact that it feeds upon almost every plant wild or cultivated; the caterpillars also seem much less susceptible to injury from the ordinary poisonous insecticides than most of our native caterpillars and being an introduced insect, of which all the members of the present devastating hordes were derived from one nest of healthy eggs, the species is not attended by the natural parasites which in Europe keep, as a rule, its numbers within reasonable bounds.

It seems strange that so voracious a creature as the Gypsy moth caterpillar could have increased so largely as is described in several letters from correspondents which are published in the 1894 report, without having attracted sufficient notice for some one to have sent specimens to the official Entomologist of the State sooner than 1889. Mrs. Belcher, of Medford, Mass., writes: "Mr. Trouvelot, who is said to have introduced the Gypsy moth into this country, was a next door neighbour of ours. The caterpillars troubled us for six or eight years before they attained to their greatest destructiveness. This was in 1889. They were all over the outside of the house, as well as the trees. All the foliage was eaten off our trees, the apples being attacked first, and the pears next. They ate nearly every green thing in my yard, killing my rose bushes and doing much damage to the vegetables. No one who did not see them at that time, can form any idea of what a pest they were. We killed many with boiling hot water, and would then dig a hole and bury them so as to prevent a stench. Mr. Belcher was poisoned by them. While he was killing them upon the trees, they would get upon his neck and poison it. It was impossible to stay long in the garden, for they would crawl all over one. We fought them for two or three years before the Commission took hold. When they hatched out in the spring, our fence would be one living mass, and while they were small it was almost impossible to keep them off one's person."

Mr. J. P. Dill, of Medford, also gives a graphic account descriptive of the great numbers and annoyance due to this scourge: "The caterpillars first appeared in May and were at their worst in July. They ate all the leaves off the trees until it seemed as though fire had run through them, trees finally becoming as leafless as in midwinter. After eating the apple tree leaves, they completely stripped a Bartlett pear tree. We got no fruit from either the pear tree or the apple trees that year. That summer we could have got the caterpillars out of the holes in the trees by pecks. After the caterpillars had eaten all the leaves off the trees, they went down into the grass where they swarmed. When the plague was at its worst, that summer, I do not exaggerate when I say that there was not a place on the outside of the house, where you could put your hand without touching caterpillars. At the time the caterpillars were the thickest on the trees, we could plainly hear the noise of their nibbling at night. It sounded like the pattering of very fine rain drops. If we walked under the trees, we got nothing less than a shower bath of caterpillars, which spun down from the trees by hundreds, even when they were of large size."

There are several letters in the same tenor, bearing evidence to the enormous numbers of this pest at the time when the assistance of the State Entomologist was sought in 1889. We find that immediately following this, vigorous steps were taken to make known the gravity of the occurrence, and the Legislature was induced to make appropriations and appoint the Commission, which, by its energetic and successful efforts, has attracted the attention and admiration of the whole world.

Undoubtedly, one of the reasons that this insect made such headway without being noticed generally, was the culpable and unpardonable ignorance which prevails everywhere and in all countries, even among sensible people, concerning the habits of the injurious insects which yearly destroy such vast quantities of produce of all kinds. This ignorance on the part of the public is unpardonable, because it is in a large measure unnecessary; not only have efficient remedies been found out by officers paid by themselves through the State treasury, but the results of the work of these officials are in most cases at the disposal of anyone who will ask for them. Another reason that the pest did not sooner

Fig. 44.—Gypsy moth, chrysalis.

attract attention, was probably that the caterpillars feed normally at night, and during the day hide in cracks and crevices of the bark, or rest on the trunks of trees, where by reason of their colouring they are not easily detected. It is only when their numbers become excessive and the food supply is diminished, that they feed at all times of the day and night, and wander from place to place. A feature of the work of the Commission has been the making known, as widely as possible, the appearance of this insect in all its stages. Not only were beautifully coloured plates published in all the reports, but show cases were made up and distributed to schools and public institutions, illustrating by actual specimens the appearance of the eggs, caterpillars, chrysalis, and perfect moths.

The eggs are laid from July to September in oval or rounded clusters, containing from four to five hundred eggs, covered with the yellowish hair from the body of the female. These clusters of eggs are placed indiscriminately on any object near to where

the female emerges from the chrysalis (Fig. 44), on trees, fences, stone walls, etc. They are mostly laid about the middle of July, and do not hatch until the following spring. Both the egg-laying and the hatching of the young caterpillars are very irregular, so that the insect may be found active throughout the season. The caterpillars (Fig. 45), although extremely voracious, take a long time to complete their growth. When full-grown, they are nearly two inches in length, and although gaudily marked when examined closely, they are nevertheless inconspicuous when at rest on trees. "The general colour of the body is creamy white, thickly sprinkled with black. The ground colour shows in the dorsal and lateral lines which are somewhat broken. The tubercles on each side of the dorsal line from the second to the sixth inclusive are blue and give rise to short black

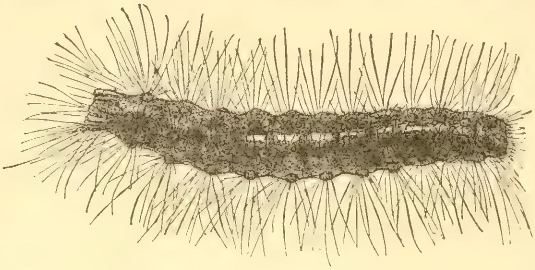

Fig. 45.—Gypsy moth, caterpillar.

spines. On each side of the remaining segments, except the last, the tubercles are dark crimson. On the top of the tenth and eleventh segments, on the dorsal line is a small cylindrical fleshy tubercle without hair or spines, the top of which is slightly inverted. It is uncertain what is the function of these organs, but it is quite possible they are scent organs."

"On the posterior edge of the last segment are four bluish-white tubercles giving rise to black spine-like hairs. The spiracles are oval, pale yellow, and encircled with black. The legs are dark crimson and the pro-legs flesh-coloured and streaked with reddish-brown."—(*Fernald.*)

There are other but less conspicuous markings, which it is not necessary to mention here. When full-grown, the caterpillars spin a small quantity of silk and change to the chrysalis condition. This usually occurs in July or August, and in Massachusetts the insect remains in this state from eight to twelve days.

Fig. 46.—Gypsy moth, male.

Fig. 47.—Gypsy moth, female.

The male (Fig. 46) and female (Fig. 47) moths are very dissimilar in appearance. The former measure from one and a half to two inches across the expanded wings. The ground colour of all the wings is brownish-yellow, varying in intensity in different examples. The head, thorax and antennæ are grayish-brown. The wings are crossed by about four waved black lines which are darkest on the costal edge of the wings. The terminal space is also darker than the rest of the wing, and the fringe is cut with dark brown between the veins. The males fly easily, in which they differ from the females, which can only fly down from an elevation.

The females are larger, varying from one and a half to two and a half inches between the tips of the wings; the entire body is white, except the abdomen beneath and the tip above, which are yellow. The markings on the fore wings are dark brown, or nearly black, but in some specimens are almost obliterated. The figures shown herewith have been kindly lent by Prof. Forbush, and give the general appearance of the markings of the two sexes, the chrysalis and the caterpillar.

The methods which have been adopted in the prosecution of such extensive operations as have been necessary, have been changed from time to time according to circumstances and experience, and many valuable data have been recorded which will be of great assistance for reference in future work. For carrying on this warfare, it was necessary to train all the inspectors and the many men required to cover the ground, and to attend to the many details connected with the destruction of the insect in its various stages, and the prevention of its spread into other districts. This involved an immense amount of careful work, which naturally took much time and money. A small hand-book, entitled "Laws, Rules and Regulations relating to the extermination of the Gypsy Moth," was printed for the use of the employees, giving a copy of the Act of 1891, authorizing the work, "Rules and Regulations for the Public," most complete "Rules and Regulations for the Agents" employed, and finally a very complete but concise account of the life history and habits of the Gypsy moth.

The methods employed were briefly as follows: The destruction of the egg was effected by saturating the clusters with creosote oil, dilute nitric and carbolic acids. For the caterpillars, trees were banded with burlap, which provided a hiding place in which they were afterwards destroyed; or a material called "raupenleim" or "insect lime," was placed upon the bands to prevent the caterpillars from climbing trees. Underbrush was cleared out wherever possible, and useless and hollow trees which would form hiding places, were cut down and burnt. Traps were also devised in which females were enclosed for the attraction of the males, which were successful. Wherever possible, shade trees, orchards and woodlands were sprayed with poisonous mixtures. As it was known that the moths were disseminated mainly by vehicles driving beneath trees in infested centres, efforts were made to inspect all vehicles going out of such districts and to clear thoroughly all trees along the roads. Great care seems to have been taken to obtain an accurate knowledge of the extent of the infested territory. Prof. Forbush, in his 1894 report, says: "The means, which though expensive, have given the best results and have finally exterminated the moth from localities and towns, consist of a thorough long-continued and repeated search by competent men, not only of all known infested localities, but of entire towns. The moth is now so rare in most of the infested towns that it is only by such search that it can be found, and this search must be relied upon to assure extermination. When a colony is found, all forms of the moth must be destroyed; loose bark must be scraped from the trees, the undergrowth cut and burnt, all cavities which may serve for hiding places filled, and the locality carefully watched for at least two years."

Among the good results of this investigation is the discovery of the value of Arsenate of Lead as an insecticide. The experiments with insecticides made under Prof. Fernald's direction, prove that the arsenites as commonly used for spraying foliage are comparatively ineffectual against the Gypsy moth. It was found that the caterpillars will feed for days without apparent injury, upon trees which have been sprayed with Paris green or London purple, in a mixture so strong as to somewhat burn the leaves. In fact, the committee, in the spraying they are carrying on at present, have found it necessary to use arsenate of lead in as strong proportion as 10 pounds to 150 gallons of water. The great value of arsenate of lead is that it can be used freely upon foliage without danger of injury to the plant, as is the case with the generally used arsenites, Paris green and London purple. The greatest success in clearing the infested districts seems to have been secured by destroying the eggs late in the summer and in early fall, as soon as possible after they are deposited. If they are not disposed of at this time, some of the egg-clusters may be broken, and the eggs scattered by man, animals, or the elements. The treatment with acids is preferable to collecting, as there is less danger of breaking up the clusters and dropping

the eggs. For the destruction of the caterpillars, Prof. Forbush reports that "the method of banding the trees with burlap is the most effective one yet devised to dispose of this form of the moth. The burlap offers them a convenient shelter, and if it is put on all infested trees, and frequently examined, many caterpillars will be caught that would otherwise escape notice. One hundred and fifty thousand yards of this material were purchased. It was cut into strips and applied to the trees in infested localities. It is necessary to examine the burlap bands once each day, or at least once in two days, to be sure of securing all the caterpillars which gather beneath them."

In view of the great difficulties which the commission had to face in solving the problem of the extermination of the Gypsy moth, the immensity of the work, the impossibility of forming a true estimate of the extent of the infested country or of the money required and, as it turned out, of the habits of the insects and the best remedies, too great credit cannot, I think, be given to those who have so wisely and ably directed the efforts to stamp out this dire enemy.

It will, indeed, be short-sighted policy, if the Legislature of Massachusetts does not now provide the funds necessary to finish up this good work. For nothing is more certain than that, if the amount estimated by the director with all the experience of the past three years, as absolutely necessary, be not forthcoming, not only will all the good work already accomplished be nullified, but at some time in the future it, and much more, will have to be done over again at a far greater expense. In concluding his last report, Prof. Forbush says: "The statute under which the committee is appointed, calls for extermination. The cost of extermination is great. It certainly costs more to search for the last egg-cluster, caterpillar or moth, than it would to destroy the majority of them and thus prevent both dissemination and damage for the time being. But if larger sums of money than those already appropriated can be secured and the extermination of the moth can be accomplished, an expense will be stopped, which must otherwise be continually increasing and which must be borne annually for an indefinite period, either by the State or by all residents of the country over which the moth would extend its constantly widening range. Encouraging progress towards extermination has already been made with manifestly insufficient funds and in the face of many obstacles. The numbers of the moth have been so reduced that no material damage has been done by it during the past two years. It has been exterminated first from single trees, then from orchards, woodlands and entire towns. More than 800 infested localities have been entirely freed of its presence. This work was begun on the borders of the infested region, and has progressed toward the centre until the moth appears now to have been exterminated from more than one-third of the region infested in 1891."

This was written in February, 1894. In Prof. Fernald's report, published in the same volume, are statements from six of our most prominent official entomologists, all of whom testify to the admirable way in which the work has been carried out. Prof. Packard says: "It seems to me that the work is practical and thorough throughout." Prof. Weed, of New Hampshire, says: "I have never seen a series of similar experiments carried on in so large a scale or in so thoroughly scientific a manner." Dr. Fernald, of Pennsylvania, says: "A careful consideration of the methods used and of the results already obtained, has convinced me that the extermination of the Gypsy Moth is not only possible but certain, if the work be prosecuted for a sufficient length of time." Prof. John B. Smith says: "The force has accomplished wonders, and I feel that there is very good reason for the belief that the Gypsy moth can be exterminated, provided the means are furnished." Dr. Lintner, of New York, says: "How a work of such magnitude, extending over so large a territory, could have been accomplished was a wonder and an enigma to me, until I became acquainted with the means by which it had been brought about."

THE SAN JOSÉ SCALE. (*Aspidiotus perniciosus*, Comstock).

By James Fletcher, Ottawa.

The unexpected discovery, in the Eastern United States and British Columbia, of this scourge of the Pacific Coast orchards, makes it all-important to draw the attention of Ontario fruit-growers to the subject, so that they may become familiar with its appearance and be prepared to adopt active measures to eradicate it, should it, as it is more than probable, appear in our province.

In August, 1893, the first eastern specimens of the San José scale were brought to the notice of the United States Entomologist, and he at once took active measures to find out all that was to be learned concerning its distribution and injuries, with the object of stamping out such a formidable enemy. In April, 1894, Mr. Howard issued a circular under the caption, "An Important Enemy to Fruit Trees," in which he gave a short history of the insect and the most approved remedies. He has been kind enough to lend Fig. 48 from that bulletin, which will be of great service in giving an idea of the appearance of the insect.

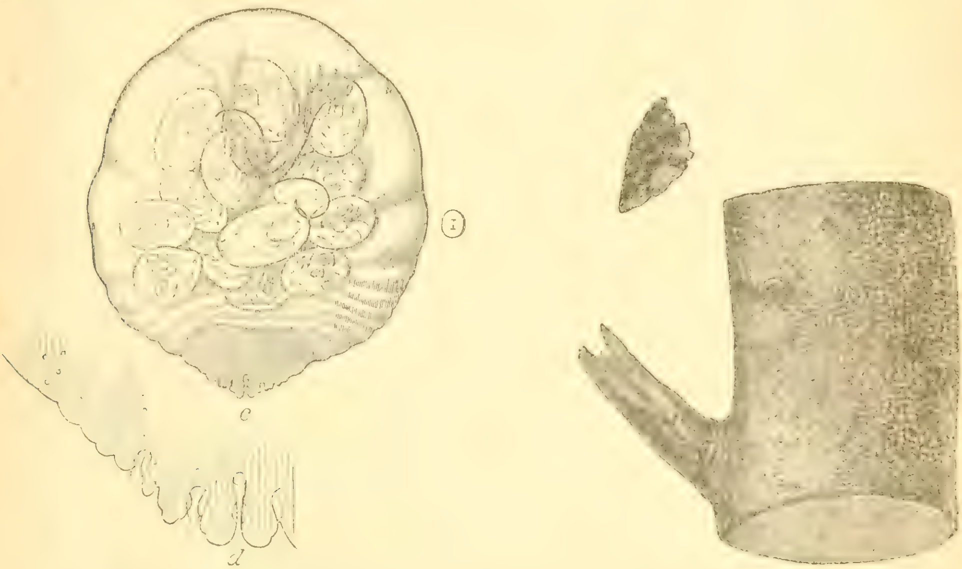

Fig. 48.—San Jose Scale, female enlarged and part of infested branch (life size).

The San José Scale was first brought to California it is thought, from Chile about 1870, and it was first noticed as injuriously abundant at San Jose in 1873, and called the San José Scale. "It does not seem to have been named scientifically until 1880, when Prof. Comstock described it in his annual report to the United States Department of Agriculture—he designated it *perniciosus*, because he considered it the most pernicious scale insect known in the country. It swarmed in countless numbers upon the trees in certain orchards, and infested all the deciduous fruits grown in California, except the apricot and Black Tartarian cherry. In the course of twelve years, the insect spread through all the fruit growing regions of California, through Oregon, and into the State of Washington. It is known as the worst insect pest of deciduous fruit trees on the Pacific coast, and has caused great pecuniary loss. Many crops of fruit have been ruined, and thousands of trees have been killed." (L. O. Howard, Circular 3.)

In 1892 the insect was found in New Mexico on apple, pear, plum, peach, quince and rose. It had been brought into New Mexico upon young trees from California. Nearly all the other instances of infestation east of the Rocky Mountains can be traced to two nurseries in New Jersey, where the pest had been introduced in 1886 or 1887 or

trees of the Japanese plum "Kelsey," which had been procured from the San Jose district in California. Idaho pear trees had also been frequently imported from California which were most probably infested. In 1891 and 1892 several blocks of young apple trees were badly infested. It is on pear trees chiefly that this pernicious scale has been distributed through the state of New Jersey. Prof. J. B. Smith says (Insect Life, VII., p. 166): "The Idaho pear has been the most dangerous because it came infested whenever imported direct, and after it came in close order, Madame von Siebold, Garber, Lawson, Seckel, Lawrence and Bartlett. Other varieties are also infested, but less frequently, and the scales do not do so well. Kieffers alone are absolutely exempt, and closely following comes the Leconte, which is rarely infested in the nursery, and never in the orchard, in my experience. One tree grafted with Lawson and Kieffer had the Lawson branch and fruit covered with scales, while the Kieffer branch was entirely free. Currants, black and red, became rapidly infested, and the scales were certainly distributed on these plants."

Mr. Howard says that this insect spreads rapidly for a scale insect, and is the most dangerous scale known. It is, too, inconspicuous and would be overlooked by many. Specimens of infested apple boughs received from British Columbia were entirely incrusted with the scales so as to give them the appearance of having been dusted with ashes. Mr. Howard gives the following description of the scale in his circular above referred to: "The San Jose Scale belongs to the same group of scale insects—the Diaspinæ, or armoured scales—to which the Oyster-shell Bark-louse of the apple belongs. It differs from this species, and in fact from all other eastern species found upon deciduous fruit trees, in that the scale is perfectly round, or at most very slightly elongated or irregular. It is flat, pressed close to the bark, resembles the bark of the twigs in colour, and when fully grown is about one-eighth of an inch in diameter. At or near the middle of each scale is a small, round, slightly-elongated, black point; or this point may sometimes appear yellowish. When occurring upon the bark of the twigs or leaves, and in large numbers, the scales lie close to each other, frequently overlapping, and are at such times difficult to distinguish without a magnifying glass. The general appearance which they present is of a grayish, very slightly roughened scurfy deposit.

The natural rich reddish colour of the limbs of the peach and apple is quite obscured when these trees are thickly infested, and they have then every appearance of being coated with lime or ashes. When the scales are crushed by scraping, a yellowish oily liquid will appear, resulting from the crushing of the soft yellow insects beneath the scales, and this will at once indicate to one who is not familiar with their appearance the existence of healthy living scales on the trees. During winter the insect is to be found in the half-grown or nearly full-grown condition. The young begin to hatch and to crawl from under the female scales shortly after the trees leaf out, and from this time through the summer there is a constant succession of generations. The insect affects not only the young twigs and limbs, and with young trees, the entire plant, but is also found upon the leaves and upon the fruit. When abundant, the fruit is destroyed. One of the most characteristic points in the appearance of the insect upon fruit, is the purple discoloration around the edge of each scale.

The above description will enable fruit-growers to recognize this enemy, should they be unfortunate enough to get their orchards infested with it.

Remedies.

With regard to remedies, we have the advantage of all the experience of Californian experimenters and the careful work of the Division of Entomology at Washington, as well as of Prof. J. B. Smith of New Jersey during the past year. There are three methods which have proved effective in fighting the San Jose Scale. In cases of severe attack it is recommended to cut down the infested trees and burn them. The other methods are, spraying with insecticidal washes, or fumigating the trees with poisonous gases. The insecticidal washes may be divided into summer washes, which can be applied while the trees are in leaf, and winter washes of a

stronger nature, which would injure the foliage but will do no harm to the trees during the winter, when they are in a dormant condition, and yet will have the effect of destroying the scale insect. Of the *summer washes*, the ordinary kerosene emulsion (Riley-Hubbard formula) and a resin wash [resin 20 lbs., caustic soda (70 per cent. strength) 5 lbs., fish oil 3 pints, water 100 gallons] were recommended by Mr. Howard, and used with success during the past summer. On peach trees, owing to the susceptibility of the foliage to injury, the stock kerosene emulsion was diluted with fifteen times its volume of water, instead of nine times, the usual strength advised for most other plants. It was found advisable to repeat the sprayings at intervals of about a week. The young scale insects were noticed on May 19th at Riverside, Md., and the females, viviparous in habit, gave birth to young for a full month. This was upon peach trees, and it was found that the resin wash killed the scales more quickly than the very diluted kerosene emulsion, and, as Mr. Howard points out, this rapidity of the work is important, since where a full-grown female is sprayed with kerosene emulsion, she may live for three or four days, during which time she brings forth young; whereas if sprayed with the resin wash, fewer young scales are produced. The resin wash, however, is readily carried off by the rains, while the kerosene is more resistant.

In Professor J. B. Smith's investigations in Pennsylvania, it is recorded (Insect Life, VII, p. 159) that, "he has visited the locality at Atglen, Pa., and found that in an orchard of over 7,000 trees, all of certain varieties, and a few of others, were infested by the scale. As a result of his recommendations, kerosene emulsion has been applied three times to most of the trees at intervals of ten days, up to the first week in June. The treatment has been absolutely successful."

For *winter washes* the kerosene emulsion and resin washes may be made stronger. The stock kerosene emulsion has been used diluted with only four and a half parts of water, and for the resin wash the same ingredients were used in the following proportions: Resin, 30 lbs.; caustic soda, 9 lbs.; fish oil, 4½ pints; water, 100 gallons.

"The most favored winter remedy in California, however, is the lime, salt, and sulphur mixture. This consists of unslaked lime, 10 lbs.; sulphur, 5 lbs.; stock salt, 5 lbs.; water to make 15 gallons. This wash will do great damage to the trees if applied during the growing season, *and should be used only in winter*. All the sulphur and half the lime are placed in a kettle and 8½ gallons of water added, after which the contents of the kettle are boiled briskly for about an hour. The solution which at first is yellow from the sulphur, will turn very dark brown, assuming more or less of a reddish tint, and will finally change from a thick batter to a thoroughly liquid condition, the product being ordinary sulphide of lime. All the salt is added to the remaining 5 pounds of lime and the latter slaked, after which the slaked lime and salt are added to the sulphide of lime already obtained, the whole being then diluted with water to make 15 gallons. This should be strained before application, as it does not form a perfect liquid solution on account of the considerable quantity of undissolved lime, which will soon sink to the bottom unless the solution is constantly stirred while being sprayed."

The third method of fighting scale insects is known as the Gas Treatment. This has been extensively used in California but is an expensive operation, and the materials necessary are very poisonous and dangerous to have about. It consists, briefly, of covering the tree to be treated with an air-tight tent and then filling the tent with the poisonous fumes of hydrocyanic acid gas, which is generated by placing 1 oz. of cyanide of potassium, 1 fluid oz. of sulphuric acid, and 3 fluid oz. of water in an earthenware vessel beneath the tent. The gas is very light and rises to the top of the tent, and if this be kept on the tree for half an hour, every scale will be destroyed. The quantity of ingredients given above is sufficient for a tent enclosing 150 cubic feet.

What is wanted, however, is to know *the best remedy*, and it is satisfactory to learn that on the whole the standard remedy for scale insects, kerosene emulsion, is the best. In summing up his experience of the year, Mr. Howard says as follows: "Remedial work against this insect is onerous, but our experience has shown that three sprayings at intervals of ten days during the latter part of May and June, will practically destroy

the insect, whether the spraying be conducted with very considerably diluted kerosene emulsion or with a resin wash, while during the winter a single application of either of the three winter washes will greatly reduce the numbers of the insect. Among the winter washes our experience leads us to give the preference to strong kerosene emulsion ; next, to the winter resin wash ; and finally, to the lime, salt, and sulphur mixture.

The kerosene emulsion is now well-known to most Canadian fruit-growers ; but it may be well to give it here.

Kerosene (coal oil)	2 gallons.
Common soap or whale oil soap	$\frac{1}{2}$ pound.
Water	1 gallon.

Cut up the soap and boil in the water till all is dissolved, then add it boiling hot to the coal oil; churn the whole briskly for five minutes with a syringe or force pump. When the emulsion is perfect, it will adhere without oiliness to the surface of glass, and when cooling forms a jelly-like mass, which can be kept indefinitely if stored in a cool place and covered from dust.

When required for use, for a summer wash dilute one part of the stock made as above with nine or fifteen parts of water. To make the stock dissolve easily, take first three parts of hot water to one of the emulsion, and then, when all is thoroughly mixed, add sufficient cold water to make the nine or fifteen parts required ; for a winter wash mix with four and a-half or nine parts of water.

INJURIOUS FRUIT INSECTS OF THE YEAR 1894.

By J. Fletcher, Ottawa.

The season of 1894 has been a busy one for the practical entomologist. Not only have the usual complaints come in of injury by the canker worm, codling moth, curculio, cut worm, etc., but beside these there have been special developments of some well-known species, and some new invaders have appeared within our borders. Of these last the most notable are the Pear-tree Psylla, which occurred in large numbers in an orchard at Freeman, Ont., and the San Jose scale, of which undoubted specimens were sent in from British Columbia. The attention paid generally to the remedies advised by entomologists is decidedly much greater to-day than it has ever been before. This is largely due to the satisfactory results which have been obtained by new methods in treating insect enemies, and also by the even more remarkable successes of botanists in controlling fungous diseases. The combined application of fungicides and insecticides is still being carefully studied and the practice of adding Paris green or some other arsenite to the Bordeaux mixture for the treatment of fruit trees, has now been widely adopted by the best fruit-growers. The late action of the British Columbian Government in condemning and destroying shipments of fruits which on arrival were found to be infested by injurious insects illustrates the vigorous policy which has been adopted by the Provincial Board of Agriculture to protect their important fruit industry. This action will also doubtless have the effect of turning the attention of careless and improvident fruit-growers to the subject, and of inducing them to adopt the simple and cheap remedies which entomologists have been advocating for the last ten years and which must certainly result not only in increased wealth to themselves and the province, but gradually in reducing very materially the amount of injurious insect-presence in the Dominion.

The insect which was the cause of the condemnation of the shipments of apples in British Columbia, was the codling moth (Fig. 49 shews the work of the grub in the fruit) which, remarkable as it may seem, has not as yet been authentically recorded as breeding in British Columbia, although it is perhaps to-day the worst enemy of the apple in Eastern Ontario. If it be true that the codling moth is not already established in British Columbia, the wisdom of the Government of that Province in using every reasonable means of keeping it out, must commend itself to everybody.

Two of the worst enemies of the fruit grower are the codling moth (*Carpocapsa pomonella*) and the plum curculio (*Conotrachelus nenuphar*). [Fig. 50 represents all stages of the insect.] After a great many experiments under varying circumstances, spraying the trees with Paris green (one pound of Paris green, one pound of fresh lime and 200 gallons of water) still remains the best remedy; I believe that whether these insects are known to be present or not, it will well repay fruit growers to spray their orchards at least once every spring as a regular operation. Numerous instances have been reported to me of astonishingly successful results from following this course, and hardly any failures; so I can repeat what I said last year, that "where this work is done carefully and intelligently, it is practically all-sufficient." The occasional cases of failure which are sometimes heard of, and these are very rare, are almost invariably due to careless work. In the January number of the *Canadian Horticulturist*, I published an open letter requesting fruit-growers who had failed to obtain paying results from spraying plum or apple trees, to write to me on the subject After nearly a whole year, I have not

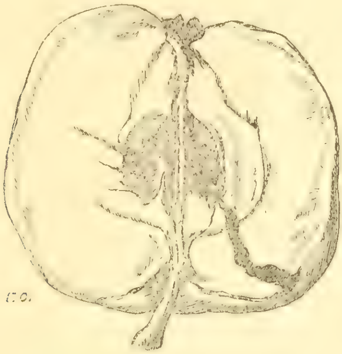

Fig. 49.—Codling moth larva in apple.

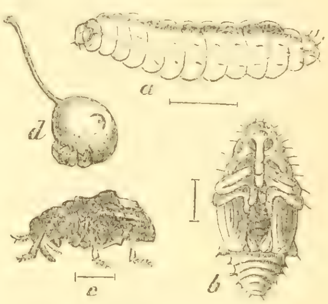

Fig. 50.—Plum curculio.

received a single unsatisfactory reply; furthermore, at the last annual meeting of the Fruit Growers' Association of Ontario, held at Peterboro', the question of spraying apple trees for the codling moth and plum trees for the curculio, came up for discussion. During this meeting which I had the pleasure of attending, I requested those present who had sprayed with Paris green against those insects, to give the results of their experience. Some convincing instances were given by leading members of the Association, which proved the efficacy of the treatment recommended.

Scale Insects.—Considerable injury is undoubtedly due throughout the whole Dominion to the operations of the inconspicuous but very pernicious scale insects; the most redoubtable of these is the Oyster-shell bark-louse (*Mytilaspis pomorum*, Bouche), and it competes every year with the codling moth for the honour of being the worst enemy of the apple tree. The life history, in this species as well as in most others, gives us a suggestion as to the best time to apply a remedy. The scales (Fig. 51) may be found upon the twigs and branches of apple trees, black currant bushes, mountain ash, ash and many other trees during the winter. From these during June emerge minute, white mite-like insects with six legs (Fig. 52), which for a few days crawl about the trees seeking for a suitable spot for them to attach themselves. This is generally on the young wood of the previous year. It is only during these few days that they are able to move, for having chosen a spot they pierce the bark with their needle-like beaks and remain fixed for the rest of their lives. Each gradually secretes a waxy mantle (Fig. 52, 3), and by August has transformed into a scale (Fig. 52, 7), in the case of the females, covering a cluster of eggs. The scales of the males are much smaller than those of the females and of a different shape. The eggs do not hatch until the following June. While the young are in the active state they are very much more susceptible to injury than after the scales are formed. The time of hatching varies somewhat in different localities, but by examining the trees this date can be easily ascertained, and if the trees are then sprayed with a

diluted mixture of kerosene emulsion the insects will be destroyed. A good time also to spray the trees, is early in spring before the buds burst. It is a matter of surprise to some how these insects which pass their lives for the most part attached firmly to the bark can spread so rapidly through an orchard, as they frequently do. This has been explained by the suggestion that at the time the young lice first hatch, they are very active and crawl

Fig. 51.

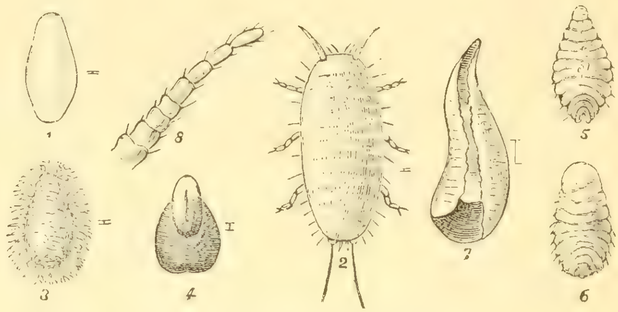

Fig. 52.—Oyster-shell Bark-louse.

with great agility. At this time of the year, the trees are much frequented by birds and other insects, upon which the lice crawl and are then carried from tree to tree by these larger winged creatures.

Belonging to this same class of scale insects, is the pernicious San Jose scale which on account of its importance, is treated of in a separate article.

Another enemy of fruit trees which has this year for the first time appeared in the Dominion, is the Pear-tree Flea louse, (*Psylla pyricola*, Forster), specimens of which were sent in from Freeman, Ont., by Mr. J. S. Freeman, who writes: "I have a block of 300 dwarf Duchess pear trees mixed with apple trees, which are so badly affected with the insects which I am sending you, that from the appearance of the trees at present, the whole crop will be destroyed. I do not think that the pear trees have been troubled before this season. They are more or less over the pear trees of different kinds in my nine-acre orchard. From inquiries of other fruit-growers in this section, I think it likely that this pest occurs in other orchards too." At the time of receiving the specimens the insect was in the pupal form and just about to assume the perfect state. Mr. Freeman was written to as to the nature of the insect, and he was recommended to spray his trees with kerosene emulsion at the time and to repeat the application early next spring when the buds burst, that being the season when the young hatch from eggs laid by females which are now hibernating on the trees. This has been found to be the most successful treatment.

The Pear-tree Flea-louse belongs to the same class of insects as the aphids or plant lice, with which they form the second section of the *Homoptera*, known as *Dimera*, or those with two-jointed feet. In this section we find small insects with antennæ longer than the head and in the winged individuals four wings, ordinarily all of the same membraneous texture. The *Psyllidæ* or flea-lice are small insects found on leaves and in some species, as the Hackberry flea-louse, give rise to galls. They have long slender antennæ terminated by two bristles. The beak is short and tri-articulate, and the eyes are lateral and prominent as in the *Cicadae*. In fact, these little flea-lice, although seldom much more than one line in length, very much resemble *Cicadae* in miniature. On the front of the face are three ocelli placed in a triangle, the posterior ones quite close to the eyes. Unlike the *Aphides* or plant lice, the flea-lice have the power of leaping, from which they take their English name.

The Pear-tree Flea-louse is an introduced insect which was first recorded as injurious in America in 1833, according to Dr. Harris. It seems to be widely distributed in the Eastern United States and occasionally has developed into a serious pest. It has been treated of at various times by Dr. Lintner, Dr. J. B. Smith and the Washington Entomologists. The most important articles are those by Prof. Lintner in his Ninth Report and Prof. Slingerland in Bulletin 44, Cornell Univ. Agr. Exp. St., October, 1892, where a complete account is given of its life history and habits.

The presence of this insect is easily detected by the copious secretion of honey dew with which the leaves of the infested trees are covered and which soon becomes covered with the dirty looking black fungus (*Fumago salicina*), and also, after a time, by the falling of the foliage. The insect itself is about one-tenth of an inch in length, of reddish brown colour, with broad black bands across the abdomen, with transparent wings, the fore wings bearing one large vein which is divided into three forks, which again are bifurcated at the extremities. The immature insect, when first hatched, is a curious flattened oval creature, semi-translucent, yellow and very inconspicuous, only one-eightieth of an inch in length. It grows rapidly and in about a month passes through the five nymph stages, the last two of which are called the pupal stages and have black wing pads and blotches of the same colour on the body. Dr. Lintner records at least four broods during the season. An encouraging feature noticeable in all the accounts of this insect is the irregularity of its appearance, its occurrence in large numbers one year very seldom indicating that it will be as abundant the next.

Another very troublesome enemy of the fruit-grower is the Cigar Case-bearer of the apple (*Coleophora Fletcherella*, Fernald), which has been sent in from several places in Ontario and the Maritime Provinces. The first specimens were from Mr. Edwin Worden, of Oshawa, Ont., who in March sent twigs of apple trees thickly infested with the hibernating larvæ of the case-bearer, and the cocoons of the interesting little moth *Micropteryx pomivorella*, Pack. Specimens of the former came also from the Grimsby district, where it was stated that Greenings suffered most. Later in the year I had a visit from Mr. Harold Jones, of Maitland, Ont., who has suffered much from this small but very troublesome insect. He estimates his loss at fully the average fruit of one hundred trees. This has proved an extremely difficult insect to control. The life history is as follows:

The eggs are laid by the tiny moths during July. The young larvæ hatch in about a fortnight, and burrowing into the leaves, feed upon the parenchyma for a short time. They then cut out from both surfaces of the leaf oval pieces of the epidermis, with which they form their curious cases. Mr. Jones observed the young larvæ beneath the leaves about the 10th of August, and by the 1st of September they were clustered on the twigs. Here they remain all the winter with their curved cases, fastened securely to the twigs with white silk. As soon as the buds open in spring, they crawl out on the twigs and attack the unfolding leaves and flowers. As the leaves get larger, they confine themselves to the leaves, feeding chiefly on the undersides, where they bore a circular hole through the epidermis and extending their bodies into the cavity between the upper and lower surfaces, make large blotch-mines. They also do much harm by attacking the stems of the flowers and forming fruit. About the third week in June the larvæ crawl to the upper surface of the leaves, and, having fastened their cases down, change to pupæ inside them; the very small dark brown moths, a quarter of an inch in length, appearing from the second week to the end of July.

The remedy, which has been tried for this insect with the greatest success, is spraying with kerosene emulsion early in spring. Dr. Young, of Adolphustown, who suffered much from this insect, writes me on July 3rd last: "On the large block of Duchess apple trees, where we sprayed with Paris green in 1891 and '92, when the case-bearers were so numerous, there is now only an odd worm to be seen; but in other parts of the orchard, where they had scarcely reached at first, they were numerous this spring. The kerosene emulsion, either warm or cold, used in the winter had no effect; but when used cold in the spring, after the worms began to move about, was very effectual. It more completely cleaned the trees of the case-bearers than did the Paris green. Still the Paris green did well, and took most of them off. We sprayed with both the same day." It is

rather remarkable that this insect, in Nova Scotia and Prince Edward Island, attacks the plum and pear as well as the apple; but at Oshawa, Mr. Worden reports that, although he has plum and pear trees side by side with his apple trees, the latter alone are attacked.

An insect which has caused considerable damage to fruit growers is the Oblique-banded Leaf-roller (*Cacœcia rosaceana*, Harris). Fig. 53 represents the moth with open wings; fig. 54, with wings closed; fig. 55, caterpillar and chrysalis. It is frequently a troublesome pest on apple trees and currant bushes. This year it was sent to me as an enemy of the birch, apple, pear, gooseberry, black currant, garden geranium, and a rare

Fig. 53.

Fig. 54.

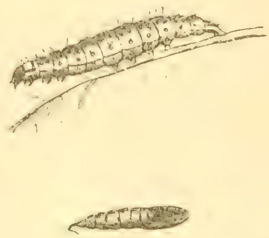

Fig. 55.

Oblique-banded Leaf-roller.

interesting attack was noted in which it was destroying the seeds only of the silver maple. In fact this insect seems to be a pest upon a large number of shrubs and trees, upon any one of which it may develop injuriously under special circumstances. The general practice of spraying fruit trees with the arsenites, for the codling moth and the leaf-eating insects, will certainly reduce largely the occurrence of the Oblique-banded Leaf-roller.

The peach orchards in the Niagara district have, during the past two years, suffered seriously from the Peach Bark-beetle (*Phlœotribus liminaris*, Harris). Careful experiments have been begun in the extensive orchards of Mr. C. E. Fisher and Captain J. Sheppard, at Queenston; and it is hoped that before long a practical remedy will be discovered. It has usually been stated that this insect attacks only injured or dying trees; this, however, is certainly not the case, for it was found in perfectly healthy and thrifty young two-year-old peach trees; although very much more abundantly in older trees with rough bark. Its ravages are chiefly confined to the peach; but, at Queenston, specimens were found in both cherry and plum. There are at least two broods in the year. The perfect beetles hibernate in shallow galleries in the bark; they are active very early in the spring, and on warm days, even in February and March, come out of their burrows. Mr. Fisher wrote me on March 13th last: "I examined the trunks of the trees, as you suggested, on a sunshiny day, and found beetles crawling with their wings set for flying. As you know, ordinarily they do not appear as if they had wings; but these had them out ready for use. The presence of this insect is conspicuously evident in wet weather, when enormous quantities of gum ooze from the trunks and fall to the ground. The work of both the larvæ and the perfect beetles seems to be confined, at Queenston at any rate, to the bark. Not a single instance of penetration of the wood could be found, although this latter attack is recorded by some observers.

The remedies which have been tried are, washing the trunks with kerosene emulsion, linseed oil, and whitewash containing Paris green. The results have been rather conflicting, but there is every reason to think that before long a sure means of prevention will be found.

Another insect, which was received from the Queenston district, and also from Fenwick, Ont., is the Otiorhynchid beetle (*Anametis grisea*, Lec). Mr. Fisher found specimens upon his peach trees, but was under the impression they did not do him much harm. Mr. E. S. Atkins, of Fenwick, however, suffered more severely; he writes: "Last year they killed 130 young peach trees for me, and ate out four rows of strawberries extending

across a six-acre field. They only attack the very first leaf-buds and the bark of the young trees when first set out ; or when a young tree is budded and cut off near the ground, by eating the bud they destroy the tree. In many of their habits they resemble the potato beetle, such as letting themselves drop to the ground and lying apparently dead ; and in warm sunny days they move about and eat, and on cold or wet ones they lie concealed at the root of the tree in the earth. When the beetles are most destructive, there is nothing to spray, as the top is cut off, and it is a mere switch with nothing to hold the mixture." As these beetles are wingless, and have to climb up the stems of trees to attack them, any mechanical means of prevention, such as a band of cotton batting or one of the various kinds of tree protectors, placed around the trunks at the time the perfect beetles occur, would prevent injury by the mature insects. In the case of young budded stock, a strip of tin bent into a ring about four inches in diameter, and pressed into the ground around the base of the stem, similar to those now so generally used by gardeners for cut-worms, might be serviceable.

I am informed by Dr. J. Hamilton that he has bred this beetle in Pennsylvania from the stems of the Rag-weed, *Ambrosia trifida*, where the larva had lived as a borer : but I think it must have some other larval habit in Canada, as this plant is only an accidental weed in a few places in Ontario.

The Spotted Paria (*Paria sexnotata*, Say,) is another beetle which requires mention as a serious pest of the raspberry. It has given great trouble on some of the fruit farms in the neighbourhood of Grimsby and St. Catharines for several years past. It was first brought to my notice by Mr. Martin Burrell, of St. Catharines, and was so difficult to control that he eventually ploughed out the whole of the infested patch. He wrote in 1892 : "My old enemy, *P. sexnotata*, has revisited me this spring in greater numbers than ever. I sprayed with Paris green, 4 ounces to 30 gallons, but the foe still 'bobbed up serenely.' Of a quarter of an acre of my raspberries not a score of canes have leafed out. I am not the only victim this year, as several of my neighbours have been severely injured by the beetles."

Mr. John Craig, Horticulturist, of the Central Experimental Farm, found this insect also very abundant early in May, in raspberry plantations on the road between Hamilton and Grimsby ; and Mr. Linus Woolverton, the energetic secretary of the Fruit Growers' Association of Ontario, sent me last spring specimens, with the report that they were doing much harm about Grimsby by eating out the fruit buds of raspberries, and thus destroying the crop. The following answer was sent to him : "The beetles you send are the Spotted Paria. This is a most injurious insect, and has done much damage in the way you describe, at St. Catharines. It seems to be very difficult to kill. I would suggest your dusting the raspberry bushes at once with Paris green and slaked lime, 1 pound of Paris green to 25 of lime. This mixture is easiest applied by putting it in a bag of cheese-cloth and shaking or tapping it over the bushes. Of course, if you can get a morning when there is a dew on them, so much the better. The beetles may also be killed in large numbers by beating or shaking them off the canes into an open pan containing water, with a little coal oil on the top. A good plan for collecting them is to hold an open and inverted umbrella beneath the canes when beating them, and then brush the insects out into the coal oil pan."

The Spotted Paria does not confine its attacks to the raspberry alone, but is occasionally troublesome to strawberries. In 1874, Mr. John McGrady, of Gatineau Point, Que., suffered a disastrous attack upon his strawberry beds. He found that hellebore was quite useless against the enemy ; and my experience is that much stronger poisons are necessary for this beetle than for many others.

There have been, of course, many of the well-known fruit pests complained of from various parts of the province, but, with perhaps the exception of the Bud Moth in the Grimsby and London districts, and *Bucculatrix pomifoliella* in western Ontario, no others demand special mention here.

SIXTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.*

The Association met at 10 a.m. in Room 12 of the Packer Institute, Brooklyn, N.Y., August 14th, 1894. The following officers and members were present:

President, L. O. Howard, Washington, D. C; Vice-President, J. B. Smith, New Brunswick, N.J.; Acting Secretary, C. L. Marlatt, Washington, D.C.

Messrs. William H. Ashmead, Washington, D.C.; Geo. F. Atkinson, Ithaca, N.Y.; Nathan Banks, Sea Cliff, N.Y.; D. W. Coquillett, Washington, D.C.; Geo. C Davis, Agricultural College, Mich.; A. D. Hopkins, Morgantown, W.Va.; Geo. H. Hudson, Plattsburg, N.Y.; J. A. Lintner, Albany, N.Y.; V. H. Lowe, Jamaica, N.Y.; F. W. Raine, Morgantown, W.Va.; William Saunders, Ottawa, Canada; E. B. Southwick, Central Park, New York City; F. A. Sirrine, Jamaica, N.Y. There were also in attendance upon the meetings visitors and members of other scientific societies, the average attendance being twenty-five persons.

The meeting was called to order by the President, and in the absence of the Secretary, Mr. Gillette, Mr. C. L. Marlatt was elected Secretary for the meeting.

The President, Mr. Howard, then delivered his annual address as follows:

A BRIEF ACCOUNT OF THE RISE AND PRESENT CONDITION OF OFFICIAL ECONOMIC ENTOMOLOGY.

By L. O. Howard, Washington, D. C.

When this Association was founded, in 1889, the name adopted was "The Association of Official Economic Entomologists," and its objects as outlined had evidently especial reference to the work of those economic entomologists who hold official positions. At the first annual meeting, held in Washington in November of the same year, Dr. Lintner, with the evident idea of broadening the scope of the Association, introduced an amendment to drop the word "official" from the title, and this amendment was adopted at the meeting at Champaign, Ill., the following year. Notwithstanding this fact, the membership of the Association is to-day largely official; out of 73 members 60 hold official positions, while the active work is all done by those with whom economic entomology is a means of subsistence. At the last meeting, held in Madison, Wis., in August, 1893, every member registered belonged to the official class.

The organization meeting at Toronto on the 30th of August, 1889, presented a strange contrast to this It was held, as may not generally be known, upon a wooded knoll at a landing called Scarborough Heights, overlooking the waters of Lake Ontario. The beach below and the woods around were being scoured by industrious collectors of the old section F, of the American Association for the Advancement of Science. Professor Cook, who presided, occupied a dignified position astride a fallen log. Dr. Smith, who acted as secretary, had climbed with difficulty to the top of a tall stump and took his minutes on his knee. Dr Bethune, Mr. Fletcher, Mr. E Baynes Reed, Mr. H. H. Lyman, Prof. C. W Hargitt, Mr. E. P. Thompson, and the writer reclined with more or less grace, according to their physical conformation, upon the ground or sat cross-legged upon convenient ant-hills This group, which made the Association "official" in name, was composed of four official entomologists and five who were simply interested workers.

*Through the kindness of Mr. L. O. Howard, Entomologist of the Department of Agriculture, Washington, D.C., and Mr C. L. Marlatt, Acting Secretary of the meeting, who prepared an abstract of the proceedings for the *Canadian Entomologist*, we are enabled to give the following account of this interesting meeting as well as some of the papers in full.—Ed.

This brief historical paragraph is introduced for the purpose of showing the interesting paradox that this Association was originally made official by non-officials, that it was subsequently made non-official by officials, and that since it was made non-official it has become more official than before.

It is in part for this reason that I have chosen to bring together for presentation at this meeting some account of the rise and present condition of official economic entomology, but more largely for the other reasons that few of us probably have been able to take a comprehensive view of the status of our application of entomology the world over, and that a review of what has been done can not but justify our existence as a class and as an association and afford the strongest of arguments for the increase of our numbers and for increase of means and facilities.

The ravages of insects on cultivated plants were doubtless coetaneous with the beginning of the cultivation of plants. Thus a necessity for economic entomologists existed at a very early time. The condition of the ancient husbandman with reference to injurious insects is voiced by the prophet Joel, when he says :

That which the palmer-worm hath left, hath the locust eaten ; and that which the locust hath left hath the canker-worm eaten ; and that which the canker-worm hath left hath the caterpillar eaten. * * * He hath laid my vine waste and barked my fig tree ; he hath made it clean bare and cast it away ; the branches thereof are made white. * * * The field is wasted, the land mourneth. * * * Be ye ashamed, O, ye husbandmen ; howl, O, ye vinedressers, for the wheat and for the barley, because the harvest of the field is perished.

In 1881 Dr. Hagen published in the columns of the *New Yorker Belletristiches Journal* (August 16) an interesting article entitled "Heuschrecken Kommissionen im Mittelalter und heute," in which he showed that grasshopper invasions have taken place since time immemorial, and that man's efforts to combat them have always ended in his discomfiture. It is not surprising, therefore, says Dr. Hagen, that the helpless multitude called on the intervention of the law and of God to deliver them from such pests ; and the legislators on one side and the priests on the other were forced to carry out the will of the people. But since written laws and legislative decrees against elemental plagues would have been ridiculous without a surrounding of imposing, legally regulated forms, the development of these formalities gradually reached a high degree of perfection. Legislation for defense against injurious animals reached its highest development in the Middle Ages. Legal procedures against all sorts of noxious animals were frequent, and the famous Burgundian legal light, Bartholomaeus Chassanaeus, wrote a book setting forth the rules according to which a suit against grasshoppers should be entered. After a court had been called together by written request, a judge was appointed and two lawyers were elected, one to plead the cause of the people and one the cause of the accused grasshoppers. The former commenced by formulating the charge, and concluded by requesting that the grasshoppers be burned. The defendant's lawyer replied that such a request was illegal before the grasshoppers had been requested in due form to leave the country. When, however, they had not left the country after a stated term, they could be excommunicated. Many years afterward, another jurist, Hiob Ludolph, wrote a pamphlet antagonizing Chassanaeus's work, setting forth the lamentable legal ignorance displayed by the latter. The accused grasshoppers, said Ludolph, must be summoned four times before the court, and if they do not appear, then they should be dragged by force before the court. Then only can the suit proceed. Other interested parties, however, shall be heard, namely, the birds that feed on the grasshoppers. Further, it would be a great injustice to banish the grasshoppers into adjacent territories. Finally, the code proposed by Chassanaeus can never be brought into accordance with the laws and rules of the Church, because there is absolutely nothing in those laws about suits against grasshoppers.

Several suits against injurious insects were brought before the courts, and the rulings have been preserved. In one case (1479) a suit was brought against injurious worms, apparently cut-worms, in the canton of Berne, Switzerland. The worms, although ably defended, lost the suit, and were excommunicated by the archbishop and banished. Regarding the effect of this awful punishment, the chronicler who relates the story adds : "No effect whatever resulted, evidently on account of the great depravity of the people."

In various other law suits the chroniclers fail to mention the final outcome; but, says Hagen, it is safe to surmise that in the whole history of jurisprudence there was never a greater disregard for the rulings of the courts on the part of the guilty parties than during the time of the mediæval insect commissions.

To attempt to enumerate the different commissions which have been established, particularly by European countries, against particular outbreaks of injurious insects, and especially against locusts, which have entered Europe from the south and from the west at intervals for many hundreds of years, would be impossible, and even if possible, would extend this paper far beyond its proper length. I shall be obliged, therefore, to neglect this phase of the subject and confine myself rather to the history of the more prominent organizations of wider scope, and these I shall treat geographically and chronologically, beginning with our own country.

THE UNITED STATES.

MASSACHUSETTS. Dr. Thaddeus William Harris was probably the first American entomologist to receive public compensation for his labors, and in this sense he may be called the first of the official entomologists in this country. In 1831 he prepared a catalogue of insects, appended to Hitchcock's Massachusetts Geological Report. "In the condition of American science at that day," says Scudder, "it was a work of inestimable value, though his only material compensation was one copy of the report and several copies of the appendix." At a later period he was appointed by the State as one of a commission for a more thorough geological and botanical survey. In this capacity he prepared his now classic report on insects injurious to vegetation, first published in full in 1841, the portion upon beetles having appeared in 1838. He reprinted the work under the name "Treatise" instead of "Report" in 1842, and again, in revised form, in 1852. The whole sum received by him from the State for this labor was $175. After his death the work was reprinted by the State in its present beautiful form, with wood engravings which themselves marked an epoch in that art. It is largely upon this work that Harris's scientific reputation will rest, and, although prepared more than half a century ago, it is to-day perhaps above all other works the *vade mecum* of the working entomologist who resides in the northeastern section of the country,

From 1852 to 1870 Massachusetts did little or nothing in economic entomology. In the latter year, however, Dr. A. S. Packard, jr., then of Salem, was appointed entomologist to the State Board of Agriculture—without compensation, however, as he informs me. Dr. Packard published three reports covering the years 1871, 1872 and 1873. They were short pamphlets, but were ably prepared, and were undoubtedly productive of very considerable good.

With the founding of the State Agricultural Experiment Station under the Hatch Act, Prof. C. H. Fernald, professor of zoology at the Massachusetts Agricultural College at Amherst, was appointed entomologist to the station. Prof. Fernald's work has been practically like that of most other station entomologists, and he has published several important bulletins. The ones for which there has been the greatest demand are No. 5 on household pests, which was the outgrowth of original studies which Prof. Fernald had made in this direction, and No. 12 containing the work upon the bud moth, spittle insects, and several other injurious species, all based upon original observation. The most important portion of his work has not yet been published. It comprehends the scientific results of his observations as entomological adviser to the gypsy moth committee of the State board of agriculture. That these results will prove of great value the writer is in full position to assert, as he has had the pleasure of seeing many of Prof. Fernald's experiments in the course of procedure, and has been greatly impressed by the ability and care with which they are being carried on. Prof. Fernald has also for some years held the position of entomologist to the State Board of Agriculture.

The work upon the gypsy moth, by the way, which has been done by the State of Massachusetts since 1889 is one of the most remarkable pieces of work, judging by results, which has yet been done in economic entomology. The operations have been carried on by a committee of the State Board of Agriculture and the means have been furnished by

large annual appropriations by the State legislature. Three hundred and twenty-five thousand dollars have already been appropriated. A territory comprising something over 100 square miles was infested by the insect, which occurred in such extraordinary numbers as to destroy many trees and almost to threaten the ultimate extinction of living vegetation, not only within the infested territory, but in all localities to which it might spread. It is unnecessary to detail the steps by which relief was brought about. Mistakes were undoubtedly made at first, and it is to the work of the present committee that the main credit is due. The infested territory has been reduced by one-half, and within the districts in which the gypsy moth at present exists it is, practically speaking, a comparatively rare species. The future of the insect is, however problematical. The continuance of sufficiently large appropriations from the State legislature to enable the work to be carried on on its present scale is doubtful, yet those in charge believe that still larger appropriations are necessary to bring about extermination. They are confident, however, that with sufficient means the insect can be absolutely exterminated from the State of Massachusetts. With the legislature disinclined to continue the large appropriations, the methods of the committtee at present pursued will have to be seriously altered. Given a small appropriation of say $25,000 annually, it will become necessary to adopt some law, like that in force in California, whereby much less frequent inspection may be made, and the committee will have to rely in part upon voluntary observers for information. Moreover, they will be unable to conduct spraying operations upon a large scale, and the expense of the destruction of insects will have to be assessed upon the owners of the property upon which the insects are found, provided such owners will not themselves undertake the destruction of the insects. There will be many disadvantages from such a course, and in the case of unproductive lands the expense will be so great that the owner will prefer confiscation. Between some such course as this and the continuance of the present methods, however, there seems to be little choice, since if the appropriation were taken away the insect will not only speedily reach its former destructive height, but will spread far and wide over the country. It may be urged that it will be only a few years before the insect will take its place as a naturalized member of our fauna and will become subject to the same variations of increase and decrease as our native species, and that it will, in fact, become little more to be feared than species already existing with us, particularly if its European natural enemies are introduced. Against this view, however, it must be urged that the gypsy moth seems an exceptionally hardy species and that even in Europe it is a prime pest. The caterpillar is tough and rugged and seems little subject to disease and to climatic drawbacks and is wonderfully resistant to the action of ordinary insecticides. The gypsy moth larva will feed for days without apparent injury upon trees which have been sprayed with Paris green or London purple in a solution so strong as to somewhat burn the leaves. In fact, the committee, in the spraying which they are carrying on at present, have found it necessary to use arsenate of lead in as strong proportion as 10 pounds to 150 gallons of water. The well-known vitality of previously introduced European injurious insects is apparently increased to a striking degree with this species, while the fact that it feeds on nearly all plants renders it a much more serious pest than any of its forerunners. Under these circumstances, therefore, any course other than an energetic and well directed effort to keep the insect within its present boundary will be shortsighted in the extreme, although it is very doubtful to my mind whether absolute extermination will or can ever be brought about.

NEW YORK. It is rather a stretch of the facts to classify Dr. Harris as an official entomologist. The first scientific man to receive a true official commission for the investigation of injurious insects was Dr. Asa Fitch, of New York. The New York State legislature, during the season of 1853-54, made an appropriation of $1,000 for an examination of insects, especially of those injurious to vegetation, and authorized the appointment of a suitable person to perform the work. The matter was placed in the hands of the New York State Agricultural Society, and at a meeting of the executive committee of the society, held at the Astor House, in New York City, May 4, 1854, the following resolution was passed :

Resolved, That Asa Fitch, M.D., of Washington County, be appointed to perform the work ; that he be furnished with such accommodations as he may desire in the rooms appointed for the laboratory in charge of the society ; and that the president and Mr. Johnson, the corresponding secretary, be a committee to prepare instructions for such entomological examinations.

Mr. William Kelly, at that time president of the New York State Agricultural Society, and Mr. B. F. Johnson, its corresponding secretary, performed their duties in the preparation of these instructions in the most admirable manner. In fact, so well were they performed that we imagine Dr. Fitch himself may have drafted the report which was signed by these gentlemen. So far as we are aware, no subsequent appointment of an official entomologist has ever been accompanied by such a full, explicit, and able paper, and for this reason we quote it in full :

As our State has had a thorough examination made of all branches of its natural history except its insects, it is of the highest importance that the remaining branch—not less in importance than the others—should receive attention. The committee feel assured that in the selection of Dr. Fitch they have secured a person every way competent to discharge the duties imposed in a manner creditable to the society and the State.

In carrying out this examination it is desirable that equal prominence be given to economical as well as to scientific entomology, that being the part of this science which is specially important to the community at large. It has been objected to the volumes of the Natural History of the State that they are too purely scientific in their character to be of special value to the great mass of our citizens, and in the work now to be performed it is obvious that it will be of very little consequence to know that a particular kind of moth or fly is an inhabitant of this State unless we are also informed of its history and habits, and whether it is a depredator upon any substance which is of value to man The habits and instincts of our insects are a proper subject of inquiry as much as their names and marks by which they are distinguished from each other. The whole history of every noxious species should at least be traced out as fully as circumstances will permit.

The examiner is therefore directed, in the first place, to make for the present season the insects which infest our fruit trees the leading object of examination. Those infesting our forest trees, our grain and other crops, our garden vegetables, our animals, etc., will remain to be studied hereafter. The examiner is desired in his examinations to search out every insect which is a depredator upon our apple, plum, pear, cherry, peach and other fruit trees, and study out all the facts in the history of each species, both in its larva and in its perfect state, as far as he shall have opportunity to do so. In this way a broad foundation will be laid, to which additions can be made which future observations may show to be necessary.

Should any important insect depredator appear the present season in any other situation than upon the fruit trees, the opportunity for studying it should not be neglected, for the same species may not appear again in many years under circumstances as favorable for becoming acquainted with its real history.

Secondly, what time is not necessarily occupied in examining the insects infesting our fruit trees should be devoted to collecting and classifying the insects of the State, and to naming and describing such species as have not been described.

A report to be prepared at the end of the season, to be submitted to the legislature, showing what has been accomplished during the season, to be divided into two parts. The first, upon economical entomology, giving an account of all that has been ascertained respecting the insects infesting our fruit trees, and any other injurious species that may have been obtained. The second, upon scientific entomology, giving a systematically arranged catalogue of all the insects of the State, so far as they are known, with a brief description of such new and undescribed as may be discovered.

The work should be pursued with a view of eventually securing to the State as full and complete accounts of all the insects of this State as far as to place this important science (which is at the present so greatly in the background, and so partially and imperfectly explored on this side of the Atlantic) in as perfect a position and as favorable a situation for being acquired as its nature will admit of. Should there be time, in addition to the above, to perform other labor, it is desired :

Thirdly, that a commencement should be made in writing out full descriptions of the species pertaining to some particular order, with observations upon the time of appearing, habits, etc., with a view of future publication, so as to secure a complete account of all the insects of the State pertaining to that order.

Lastly, suits of specimens to fully illustrate both the economical and scientific entomology of the State should be gathered in connection with the other parts of this work, to be placed in the Cabinet of Natural History ; and in the Agricultural Museum specimens of the wood, leaves and fruits ; and other substances depredated upon by each and every species of our noxious insects, showing the galls or other excrescences which they occasion, the holes or burrows which they excavate, the webs or other coverings for themselves which they construct, with preserved specimens of the worms, caterpillars, etc., by which each of these deformities is produced.

Such further examination as Dr. Fitch may deem necessary to carry out fully the objects desired to be accomplished, as from time to time may be deemed advisable, the committee desire may be made.

William Kelly,
B. F. Johnson,
Committee.

Dr. Fitch, while not officially designated as State entomologist of New York, was always given this title by courtesy, and continued in office until 1871 or 1872, when his fourteenth report was published, and when the infirmites of age affected him to such an extent that he could no longer continue his investigations. The reports were published in the Transactions of the State Agricultural Society from 1854 to 1870, skipping the years 1859, 1865 and 1868. The first eleven have been published separately, as well as

in the transactions of the society. In 1873, through an appropriation by the State legislature, provision was made for the revision and republication of the reports, and the revision was completed by Dr. Fitch. The resolution for printing, however, failed of the concurrence of the senate, and since that time the manuscript has been lost.

The value of Dr. Fitch's labors has been very great. In his fourteen reports the great majority of the injurious insects of the State of New York received more or less detailed consideration, and in the majority of cases the life histories of the insects treated were worked out with great care and detail. The remedial measures suggested by Dr. Fitch have, however, been largely improved upon, and the practical value of these reports to day rests almost entirely upon the life-history side.

From the time of the publication of Dr. Fitch's last report, in 1872, the State of New York did nothing for the encouragement of economic entomology until 1881, when the legislature, on April 14, passed an act to provide for the appointment of a state entomologist. The law reads as follows :

No. 316.] SENATE OF NEW YORK,

In Senate, April 14, 1881.

Introduced by Mr. Fowler ; read twice and referred to the committee on finance ; reported favorably from said committee and committed to the committee of the whole.

AN ACT to provide for the appointment of a state entomologist and fixing his compensation.

The people of the State of New York, represented in Senate and Assembly do enact as follows :

SECTION 1. There shall be appointed, by the governor, a state entomologist, who shall be charged with the study of insects injurious to agriculture and of methods for controlling and preventing their depredations.

P. 2. The salary of the entomologist shall be two thousand dollars, and he shall render an annual report of his labors and investigations to the legislature and shall arrange for the state museum of natural history a collection of insects taken in the course of his investigations.

P. 3. This act shall take effect immediately.

(Senate No. 316). (I. 520, G. O. 391).

(Chap. 377 of the Laws of 1881. Passed May 26, 1881, three-fifths being present.)

The movement which resulted in the passing of this law was started by the regents of the University of the State of New York at their annual meeting in 1877, and the person appointed to fill the office was Dr. J. A Lintner, a well-known worker in entomology, who, up to that time, had been connected with the State Laboratory of Natural History. Dr. Lintner has held office continuously since 1881. He brought to bear upon his duties a ripe experience and a mind trained in scientific methods. He has published nine reports, the last one covering the year 1892, and only recently distributed. These reports are in many respects models. The great care and thoroughness of the author have hardly been equalled by any other writer upon economic entomology. The form of the reports is most admirable, and the account of each insect forms almost invariably a complete compendium of our knowledge concerning it down to the date of publication. His accounts are also arranged in the most convenient form for reference, a full bibliography precedes the consideration of each species, and the frequent subheadings enable the most practical use of the report. The reports are replete with sound and ingenious practical suggestions, and are written in a straightforward, simple style, which possesses great literary merit. They abound in illustrations, and are made available by most complete indices and tables of contents. Aside from these reports, Dr. Lintner has published a great deal in the newspapers, particularly the "Country Gentleman," on the subject of economic entomology, and another valuable feature of his reports is the comprehensive list which he publishes each year of his unofficial writings.

The Cornell University Agricultural Experiment Station was established by the authorities of the university in 1879, and its first annual report contained a series of miscellaneous entomological observations by the acting professor of entomology Dr. W. S. Barnard. The second report, issued in 1883, contained an elaborate monograph of the Diaspinæ by Prof. J. H. Comstock, and an important article on the Tineidæ infesting apple trees by Mr. A. E. Brunn, a student of the Department of Entomology. With the establishment

of the agricultural experiment stations under the Hatch bill, in 1888, this experiment station became governmental in its character, and Prof. Comstock was naturally made entomologist. Since that date he, or his assistants, have published a number of very important bulletins, the first one, on "A Sawfly Borer of Wheat," by Prof. Comstock; the second on Wireworms, by Prof. Comstock and his assistant, Mr. M. V. Slingerland, and the later ones mainly by Mr. Slingerland. These are among the best and most practical of the experiment station bulletins that we have. They are characterized by almost a superabundance of detail and plainly by great care. The illustrations are very nearly all original, and are excellent.

THE U. S. DEPARTMENT OF AGRICULTURE. Almost simultaneously with the appointment of Dr. Fitch to do entomological work for the State of New York, came the appointment of an entomological expert under the General Government. On June 14, 1854, Mr. Townend Glover was appointed by the Commissioner of Patents to collect statistics and other information on seeds, fruits and insects in the United States, under the Bureau of Agriculture of the Patent Office. Mr. Glover was one of the most eccentric individuals who have ever done important work on North America insects. He had led a roving and eventful life as a boy in Brazil, as a clerk in a draper's shop in England, as an artist in Germany, as a roving traveller and naturalist in all parts of the United States, and finally as a landed proprietor with horticultural tastes on the banks of the Hudson in New York. Pomological interests brought him to Washington shortly before the time when he received his appointment. His first report was published in the Report of the Commissioner of Patents for 1854, was illustrated by six plates engraved on stone by the author and comprised some consideration of the insects injurious to the cotton plant, wheat, and the grapevine, and on the plum curculio, codling moth, and peach borer, closing with some account of the more common species of beneficial insects. His second report, in 1855, continued the consideration of the cotton insects, together with some accounts of orange insects. The reports for 1856 and 1857 contained nothing from him, but that for 1858 contains a rather full report on the insects frequenting orange trees in Florida, published over the initials D. J. B., which were those of the then chief clerk of the Bureau, with whom Mr. Glover had many serious disagreements, largely on the matter of credit, which resulted in his resignation the following year. In 1862 the Department of Agriculture was established as a separate institution, under the commissionership of the Hon. Isaac Newton, and in 1863 Mr. Glover was appointed entomologist to the Department. His annual reports follow consecutively from 1863 to 1877, and are storehouses of interesting and important facts which are too little used by the working entomologist of to-day. Their value for ready reference, however, is detracted from by a lack of systematic arrangement and poor paper and presswork, but many observations are to be found in the pages written by Glover which have subsequently been announced by others as original and important discoveries. There is, however, in Mr. Glover's reports, a lack of consecutive and full treatment of any one topic, and the subject of remedies seems seldom to have received original treatment or thought with him. This is largely due to the fact that his reports were matters of secondary importance to him, his main energies being devoted to the building up of a museum for the Department and to the preparation of his most elaborate series of illustrations of North American insects, a work upon which he expended enormous labor, and which unfortunately, up to the present time, has added to his fame nothing but the good opinion of a few of his scientific contemporaries

In 1877 Mr. Glover's health suddenly failed him. His report for that year was largely prepared by his able assistant, Mr. Charles Richards Dodge, who, by the way, is the author of the charmingly written account of Mr. Glover's life, published as Bulletin 18 of the Division of Entomology of the Department of Agriculture. Mr. Glover lived for several years afterwards, but was unable to do further work. He died in Baltimore in 1883, and the writer and Profs. Uhler and Riley were the only entomologists present at the funeral services of this, in many respects, remarkable man.

The year 1878 marked a new era in the governmental entomological work. Prof. C. V. Riley, a comparatively young man, who had already become famous by the admirable work which he had done as entomologist of the State of Missouri, and as chief of the

U. S. Entomological Commission, was that year appointed successor to Mr. Glover by the Hon. William G. Le Duc, then Commissioner of Agriculture. Prof. Riley took hold of his work with his accustomed vigor, and, during the nine months that he remained in office at that time, accomplished a great deal. His report for the year 1878, though short, is by far the most practical one which the Department had published up to that time. On account of a misunderstanding with the Commissioner, Prof Riley resigned his commission in May, 1879, and Prof J. H. Comstock, of Cornell University, was appointed in his stead. Prof. Comstock remained in office until May, 1881 He completed the investigation of the cotton worm, begun by Prof. Riley, and published a thoroughly practical and useful volume entitled "Report upon Cotton Insects," early in 1880. In addition to this report he published extensive annual reports covering the years 1879 and 1880, which rival in thoroughness and practicality the Missouri reports of Prof. Riley and those which were issued by the Department after his resignation. The report for 1880 is marked by the publication of the results of a preliminary investigation of the insects affecting the orange, and more especially by an elaborate report upon scale insects, which formed the basis of the study of this important and very destructive group of insects in this country. Upon the change of administration in 1881, Prof. Comstock was retired, with a year's commission as investigator, and Prof. Riley resumed charge of the governmental entomological work. From that time until June, 1894, Prof. Riley remained consecutively in office. The work which he has accomplished has been of the highest order, and has been largely instrumental in placing the science of economic entomology in this country upon its present sound footing. During the course of his administration of the office he has published 12 annual reports, 31 bulletins, 2 special reports, 6 volumes of the periodical bulletin "Insect Life," and a large number of circulars of information. He has developed not only the scientific side of the work, but also the practical side. Under his direction advances have been made both in insecticides and insecticide machinery, which are of the most far-reaching importance. The earlier work of Prof. Riley will be mentioned in another place, but it will be appropriate to state here that no other name in the annals of North American economic entomology stands out with the same prominence as his. His work has been called epoch-making, and this expression may be considered justified. His voluntary resignation at this time would be greatly to be deplored, were it not for the fact that, with the restoration of his health, which is confidently to be anticipated, he will resume his labors—in another capacity, it is true, but along entomological lines and with undiminished vigor.

Aside from the work of the Division of Entomology, the General Government has, upon one occasion only, provided for work in economic entomology, as have so many other governments, by the appointment of a special commission. The U. S. Entomological Commission was founded, by authorization of an act of Congress approved March 3, 1877, specifically to report upon the depredations of the Rocky Mountain locust in the Western States and Territories and the best practical methods of preventing its recurrence. or guarding against its invasions. The commission was attached to the U. S. Geological and Geographical Survey of the Territories under the charge of Prof. F. V. Hayden, and the office of chief was filled by the appointment of Prof. C. V. Riley by the Hon. Carl Schurz, then Secretary of the Interior. The other members of the commission, also appointed by the honorable Secretary of the Interior, upon consultation with Prof. Riley, were Dr. A. S. Packard, jr., of Massachusetts, secretary, and Prof. Cyrus Thomas, of Illinois. The commission remained in existence, supported by annual appropriations by Congress of varying amounts, until 1881. It published 5 reports and 7 bulletins. The first two of the annual reports related to the Rocky Mountain locust and allied migratory locusts, and form together probably the most complete monograph of any one insect ever published. The practical end was kept constantly in view, and the reports are thoroughly practical, as well as thoroughly scientific. In the appropriations for the year 1879 the commission was instructed to report upon cotton insects, and the results of the investigation thus brought about are published in the fourth report of the commission on the cotton worm and boll worm—another elaborate volume which cannot be too highly praised from all standpoints. The third report treats of a variety of topics and includes two important monographs, one upon the army worm and the other upon canker worms, while the fifth

report contains a full and comparatively exhaustive treatment of the subject of the insects injurious to forest and shade trees. The first, second and third reports are published under the joint authorship of the three commissioners, the fourth under the sole authorship of Prof. Riley, and the fifth under the sole authorship of Dr. Packard.

ILLINOIS. During the regular session of the legislature of Illinois, in the winter of 1866-'67, a law was passed enacting that a State entomologist shall, "by and with the consent of the senate, be appointed by the governor with a salary of $2,000 per annum, for a period of two years, or until his successor is appointed and qualified." This legislation was the result of a petition from the State Horticultural Society, and on May 21, 1867, the society passed the following resolution :

That the president of the society be authorized to engage B. D. Walsh to immediately commence entomological investigations in relation to horticulture, and be empowered to pay out for that purpose a sum not exceeding $500 from the legislative appropriation. This action is taken in case of failure to appoint.

At a special session of the legislature held in June, 1867, the governor sent in the name of Mr. Walsh for confirmation, but the senate postponed action upon it until the next regular biennial session in the winter of 1868-'69. Hence it follows that Mr. Walsh's first and only report was published as acting State entomologist, his untimely death occuring before his second report was prepared, its preparation having been delayed by a long period of ill-health which preceded the railway accident which was the immediate cause of his demise. Mr. Walsh was a retired farmer and lumber dealer of English university training, who for a number of years prior to his appointment had been industriously studying entomology and had written largely for the agricultural press upon the subject of injurious insects. Although not a naturalist by training, his work showed extraordinary powers of observation, and his published writings, as well as the statements of his contemporaries, indicate that he possessed a remarkable mind. In this connection, however, we have occasion to speak only of his official work as indicated in his one report. In this report, which is now unfortunately very rare, he treated particularly of the insects affecting the grape, the apple and the plum, and to this added, under the head of "Insects affecting garden crops generally," a chapter on the so-called "hateful grasshopper," or migratory locust, (*Caloptenus spretus*). His treatment of the other insects is very thorough and his work in a large part remains standard to-day.

Mr Walsh's successor, Dr. William LeBaron, a practising physician of Geneva, Ill., well known for his writings on injurious insects in the agricultural journals of the time, and an able and conscientious entomologist, published four reports as appendices to the Transactions of the State Horticultural Society, from 1871 to 1874. The first three treated of miscellaneous insects, mainly those injurious to fruit and fruit-trees, while his fourth report, and part of his third, consisted of the beginnings of a work entitled Outlines of Entomology, of which he completed only the order Coleoptera. This portion however, was executed in the most scientific manner, and was fully illustrated, largely by original drawings by Prof. Riley. It has since been used to some extent in the class room, and has undoubledly been the means of interesting many students in the subject of entomology. Dr. LeBaron's treatment of insects from the economic standpoint was careful and practical. He records in his first report the first successful experiment in the transportation of parasites of an injurious species from one locality to another, and in his second report recommended the use of Paris green against the canker-worm on apple trees, the legitimate outcome from which has been the extensive use of the same substance against the codling moth, which may safely be called one of the great discoveries in economic entomology of late years.

Dr. LeBaron died in harness, I believe, and was succeeded in office by the Rev. Cyrus Thomas, of Carbondale, who published a series of six reports, extending over the years 1875 to 1880. Mr. Thomas at the time of his appointment was a well-known entomologist, who had written extensively for the "Prairie Farmer" and other agricultural newspapers on the subject of economic entomology, and who had published an elaborate monograph of the Acridiidæ of the United States as one of the special volumes of the Hayden survey of the Territories. He started with his first report, a manual

of economic entomology for the State of Illinois, including in this report the portion relating to the Coleoptera. In his second report his assistant, Mr. G. H. French, treated of the Lepidoptera, and in his third report Mr. Thomas treated the Hemiptera, monographing the Aphididae. His fourth report included a consideration of one family of the Orthoptera, namely, the Acrididae, and the fifth a paper on the larvae of Lepidoptera, by his assistant, Mr. D. W. Coquillet, while in his sixth he was obliged, from the force of circumstances to abandon the scheme. The manual of economic entomology of Illinois remains, therefore, unfinished. In the course of the six reports a very large number of insects are treated from the economic standpoint. Mr. Thomas was able to employ several excellent assistants, and the six reports as a whole are very creditable to the State. The last of the six reports shows rather plainly the falling off in Mr. Thomas's interests in the subject of entomology. Its publication was coincident with the close of the work of the U. S. Entomological Commission, and it consists entirely of reports by Mr. D. W. Coquillett and Prof. G. H. French. After its publication Mr. Thomas transferred his labors to the field of ethnology, in which he had long been interested, and he is at the present time one of the able workers in the U. S. Bureau of Ethnology.

Upon Mr. Thomas's withdrawal from office, Prof. S. A. Forbes, director of the State Laboratory of Natural History, at Normal, Illinois, was appointed State entomologist, his commission dating July 3, 1882. Prof. Forbes's attention had for some time been more or less engaged by questions relating to economic entomology. He has held office continuously since that time, and has published six reports, the first one covering the remainder of the year 1882, the second the year 1883, the third the year 1884, the fourth the years 1885 and 1886, the fifth the years 1887 and 1888, and the sixth the years 1889 and 1890. Prof. Forbes's reports are among the best which have been published. They are characterized by extreme care and by an originality of treatment which has seldom been equalled. The practical end is the one which he has kept mainly in view. His experiments with the arsenites against the codling moth and the plum curculio were the first careful scientific experiments in this direction which were made, and his investigations of the bacterial diseases of insects have placed him in the front rank of investigators in this line. His monographic treatment of the insects affecting the strawberry plant is a model of its kind, and the same may be said of his work upon the corn bill-bugs and of his studies of the chinch bug. In fact, whatever insect or group of insects has been the subject of his investigations, he has attacked the problem in a thoroughly original and eminently scientific and practical manner. Prof. Forbes has been able to command the services of a very able corps of assistants, including Messrs. C. M. Weed, H. Garman, F. M. Webster, John Marten, and C. A. Hart.

Missouri. In the session of 1867-'68 the legislature of Missouri passed an act establishing the office of State entomologist, and directed that the reports of this officer should be made to the State Board of Agriculture. The first and only appointee to this position was Prof. C. V. Riley, who had at that time become prominent as an entomologist through his writings in the "Prairie Farmer," of Chicago, with which paper he had been for some time connected, and through his editorship, in association with Mr. B. D. Walsh, of the "American Entomologist," of which one volume had then been published. He entered upon his duties April 1, 1868, and published his first annual report in December of that year. From that date there followed annually eight additional reports, the ninth being submitted March 14, 1877, and covering the year 1876.

There is no need of any comment upon these nine Missouri reports before any body of economic or scientific entomologists. They are monuments to the State of Missouri, and more especially to the man who wrote them. They are original, practical, and scientific; they cover a very great range of injurious insects, and practically all the species which were especially injurious during those nine years received full and careful treatment. They may be said to have formed the basis for the new economic entomology of the world, and they include a multitude of observations and intelligent deductions which have influenced scientific thought. The value to the agriculturist, as well as to the

scientific readers, was greatly enhanced by the remarkable series of illustrations which were drawn by the author and engraved upon wood by the most skilful wood engravers of that time. Aside from a few of the illustrations to the Flint edition of Harris, they are the best woodcuts ever made of insects in this country, and as a whole the drawing far excels that of the Harris illustrations in its lifelike accuracy, artistic beauty, and closeness of detail. Prof. Riley abandoned his Missouri work on taking up the directorship of the U. S. Entomological Commission, and in pursuance of a shortsighted policy Missouri has never since had a State entomologist.

Other States and the Hatch State Agricultural Experiment Stations. Massachusetts, New York, Illinois, and Missouri are the only States which may be said to have supported official economic entomologists. There are letters on file in the Division, dated in 1880, from Mr. J. T. Humphreys, who announces himself in his letter head as "Late naturalist and entomologist to the Georgia Department of Agriculture;" but although I have made something of an effort to learn the details of Mr. Humphreys's employment, I have so far been unsuccessful. The State of Pennsylvania has for some years handled its economic entomology by means of an officer who holds an honorary commission from the State Board of Agriculture. This commission was held for some years prior to his death by Dr. S. S. Rathvon. At the present time Dr. Henry Skinner, of Philadelphia, and Dr. R. C. Scheidt, of Lancaster, are entomologists to the State Board.

In the spring of 1888, the State Agricultural Experiment Stations, founded under the Hatch Act, were organized. A number of entomologists were soon appointed and active work began practically in the month of February. This movement, the importance of which to American economic entomology can hardly be overestimated, is too recent to require full treatment here.

The first entomological bulletin published by any of the experiment stations was issued in April, 1888, from the Arkansas station by Mr. S. H. Crossman, and was entitled The Peach tree Borer and the Codling Moth. Bulletins from Hulst, in New Jersey; Morse, in California; Tracy, in Mississippi; Ashmead, in Florida, and Weed, in Ohio, followed in May. Popenoe in Kansas, and Perkins in Vermont, published one each in June, and Fernald, in Massachusetts, and Lugger, in Minnesota, one each in July.

Through the kindness of Mr. A. C. True, director of the Office of Experiment Stations of the U. S. Department of Agriculture, I am in possession of a bibliographical list of the entomological publications of the agricultural experiment stations down to the present month. This was drawn up by Mr. F. C. Test, of Mr. True's office, and will be published as an appendix to this address. An analysis of its contents shows that 42 States and Territories have employed persons to do entomoloigical work, and that the number of experiment station workers who have published entomological bulletins or reports reaches 77. Not half of these writers, however, have been officially designated as entomologists to the station. Of those so designated there are 28; 8 have held the title botanist and entomologist; 6, consulting entomologist; 4, assistant entomologist; 4, horticulturist and entomologist; 1, special entomologist; 1, entomologist and physiologist; 2, entomologist and zoologist; 1, entomologist and superintendent of farms; 1, director, entomologist, and botanist; 1, vice-director, horticulturist, entomologist, and mycologist; 1, special agent; 1, apiarist; 2, biologist. The other writers bear titles which indicate that they are not specialists in entomology. They are as follows: Agriculturist, 1; assistant agriculturist, 1; horticulturist and agriculturist, 1; horticulturist, 3; assistant horticulturist, 1; botanist and mycologist, 1; director, 2; botanist, 2; superintendent of grounds, 1; pomologist, 1; specialist, 1; veterinarian, 1; clerk and librarian, 1.

The entomological publications of these experiment stations have numbered 311, of which 88 have been annual reports, 213 bulletins, and 10 leaflets and circulars. In character the bulletins and such reports as have definite titles may be thrown into three categories: 1, those which treat only of insecticides and insecticide machinery, 40; 2, those which contain compiled accounts of insects, with measures for their destruction, 60; 3, those which contain the results of more or less sound original observation, with compiled matter and matter upon remedies 117. There are also two small classes: 1, apiculture, 6; and 2, classificatory, 4.

It would be a matter of very considerable interest if I were able at this time to give a more critical summary of the results achieved by our experiment station workers in entomology. The little analysis which precedes shows a gratifying preponderance of bulletins and reports which contain results of original work; and yet at the same time we must remember that while these papers advance our knowledge of entomological science, the compilations may frequently accomplish greater practical good. This point is illustrated by a statement which I have from Prof. Garman, of the Kentucky station. He says that Bulletin No. 40 of his station, containing condensed accounts of some of the commoner and more injurious insects of the farm and garden, is the one for which there has been the greatest demand. The original edition of 12,000 was soon exhausted, and another lot has since been printed. The bulletin was prepared by request, and naturally is not the sort of work which our station entomologists prefer to do. "Its success," writes Prof. Garman, "has been a lesson to me as to what farmers want and will use."

It occurred to me that it might be valuable to have a statement from each of the experiment station entomologists as to the piece of work he had done which seemed to have accomplished the most practical good, in the light of his own accurate information concerning the farming population of his State. I therefore addressed letters to nearly all of the station workers in entomology, but have received replies from only about half of them, so that a statement of this kind would hardly be justified. It is interesting to note, however, that experiment station workers place in very high esteem the results of their correspondence with farmers and of their lectures before farmers institutes and other bodies. It is in these two ways that the popular sentiment among agriculturists as to the importance of economic entomology is being much more rapidly spread than, perhaps, by the publication of bulletins upon injurious insects.

Canada

The Rev. C. J. S. Bethune, for many years one of the most prominent writers on entomology in Canada, and a well known contributor to the columns of the *Canadian Farmer* on the subject of agricultural entomology, was largely responsible for the organization of the Entomological Society of Ontario, and for the first appropriation of money made to that society with a view to the development of economic entomology among our neighbors across the border. The council of the Agriculture and Arts Association of Ontario in 1869 voted a grant of $400 to the Entomological Society of Ontario for the year 1870, on condition that the Entomological Society should furnish an annual report, should found a cabinet of insects, useful or prejudicial to agriculture and horticulture, to be placed at the disposal of the council, and that it should also continue to publish the *Canadian Entomologist.* This was the origin of the first annual report of the Ontario society, which was published in 1871 by the Agricultural and Arts Association. This association also gave the society $100 additional, and the Fruit-Growers' Association of Ontario $50 additional, to be used for the purpose of illustrating the report. During the session of the Legislature of the Province of Ontario in 1870-71 the Agriculture and Arts Act was passed. By this Act the Entomological Society of Ontario was incorporated, and a grant of $500 per annum was made to it from the Provincial Treasury. In 1872 the Legislature made an extra grant of $200 for the purchase of woodcuts, etc., making the total appropriation $700. In 1873 an extra grant of $500 was made, and the annual grant for 1874 was increased to $750. In 1875 the grant was $750, plus $100 for illustrations; in 1876 $750, plus $500 towards the expense of an exhibit at the Centennial Exhibition at Philadelphia; in 1877, 1878, and 1879 it was $750 per annum, and in 1880 the grant was increased to $1,000 at which sum it has continued since that date. The Government also pays the expense of printing the annual report.

The society has conscientiously complied with the conditions of the grant. Its reports, published annually, have greatly increased in size and in the general interest of their contents. They have contained much matter of economic value as well as of educational interest.

In 1884 the Department of Agriculture of Canada established the office of honorary entomologist, and this office was filled by the appointment of Mr James Fletcher, at that time an employee of the Government Library at Ottawa, and already widely known in entomological circles through his active interest in the Ontario society and his contributions to its publications. On July 1, 1887, Mr. Fletcher was transferred to the staff of the Dominion Experimental Farm at Ottawa as entomologist and botanist. Mr. Fletcher's footing since that date has been practically identical with that of an entomologist to one of our State experiment stations, except that his field is larger. He has published a report yearly in the Annual Report of the Experimental Farms, published as an appendix to the report of the Minister of Agriculture. Mr. Fletcher has shown himself to be a man of extraordinary energy, a most entertaining writer, and a most careful observer, and one who has always kept the practical part of his work foremost in view. He has paid a great deal of attention to a side of his work which is neglected by many of our own official entomologists, namely, personal intercourse with farmers, frequent talks on injurious insects at farmers' institutes, etc., and has in this way built up a very large clientage among the most intelligent agriculturists in the Dominion. In economic entomology Canada at the present day is perhaps in no way behind the United States, and this is largely due to Mr Fletcher's individual efforts, aided and encouraged as they are by the warm support of the eminent director of the experimental farm system, Mr. William Saunders, himself a pioneer in economic entomology in Canada and the author of one of the most valuable treatises upon the subject that has ever been published in America. Canada has the man and the knowledge, but has been hampered by want of funds. The result is that while she has immediately and intelligently adopted the results of researches made in this country, she has not been able to lead us in original investigation.

European Countries.

In general it may be said that Europe has not felt the need of entomological investigation from the economic standpoint to anything like the same extent as the United States. A climate much less favorable to the undue multiplication of injurious insects than that of North America, and which, moreover, seems to act as a barrier against the importation of foreign destructive species, the actually smaller number of injurious species and the vastly greater familiarity with all phases of the life-history of these species by all classes of the people, partly resulting from the older civilization, partly from educational methods, and partly from the abundance of elementary and popular literature on questions of this character, the denser population, and the resulting vastly smaller holdings in farms, the necessarily greatly diversified crops, the frequent rotation of crops, together with the clean and close cultivation necessitated by the small size of the holdings, and the cheaper and more abundant labor, have all resulted in a very different state of affairs regarding the damage which may be done by injurious insects. In summarizing these points, the Chief of the Agricultural Section of the Ministry of Agriculture of Prussia, in conversation with the writer last summer, argued that Germany does not need to employ general economic entomologists; that its experiment stations seldom receive applications for advice on entomological topics. Special insects, it is true, occasionally spring into prominence; the Phylloxera is one of these, and in an emergency like the Phylloxera outbreak, the work is handled by special commissions. European nations, therefore, can afford to let the insect problem alone to a much greater extent than the United States, for the reason that it is of infinitely less importance with them than with us. The most simple remedies, such as hand-picking, together with a rigid enforcement of the public regulations regarding hand destruction, usually suffice to keep injurious insects in check. Nevertheless, insect outbreaks do occasionally occur, and there is a certain percentage of loss every year from the work of injurious species. The results obtained in the United States, where the number of native injurious species is much greater than in Europe, and where we have in addition to deal with a host of imported species—in short, where the fighting of insect foes has become an absolute necessity—have, however, acted to a certain degree as incentives, not only to other countries which

labor under the same climatic disadvantages as the United States, but even to a certain degree to European countries, where more thorough investigation of injurious insects by competent persons especially appointed for the purpose is gradually becoming thought worth while.*

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Great Britain.

There is not and never has been in Great Britain a special government appropriation for work in economic entomology. In 1885 Mr. Charles Whitehead suggested to the lords of the Committee of Council for Agriculture, that it would be valuable to publish reports upon insects injurious to various farm crops. He prepared, and the council published, a series of four reports upon insects injurious to the hop plant, corn and leguminous plants, to turnips, cabbage and other cultivated cruciferous plants, and to fruit crops. In 1886 Mr. Whitehead was appointed agricultural adviser and prepared a report upon insects and fungi injurious to crops of the farm, orchard and garden for 1887-88, and in 1889 the Board of Agricultnre was formed, and Mr. Whitehead was retained as technical adviser, especially with reference to insects and fungi injurious to crops, but also with reference to other agricultural questions. He prepared annual reports on insects and fungi for 1889, 1891 and 1892, and a number of leaflets and special bulletins on insects unusually prevalent from 1889 down to the present time. I learn from Mr. Whitehead, that there is no specific law authorizing this expenditure; that his work has been continuous since 1887, and that he has received an annual sum of £250 only. The more important of the special bulletins and leaflets which have been issued have been: Special Report on an attack of the Diamond back Moth Caterpillar, 1892; Caterpillars on Fruit Trees; Hessian Fly; Moths on Fruit Trees, 1890; Apple Blossom Weevil, Raspberry Moth and the Mangel Wurzel Fly, 1892; Black Currant Mite, 1893; and the Red Spider and Apple Sucker, 1894.

While Mr. Whitehead has, therefore, been the only governmental worker in agricultural entomology, a very considerable work has been done in a semi-official way by an untiring and public-spirited woman, Miss Eleanor A. Ormerod, who is, or rather was, in her official capacity, honorary consulting entomologist to the Royal Agricultural Society. From 1876 to 1893 Miss Ormerod held this position; conducted the correspondence of the Royal Agricultural Society on the subject of injurious insects, and published at her own expense a series of annual reports, seventeen in number, which have contributed very largely to the diffusion of knowledge concerning injurious insects in Great Britain among the farming classes She has had a most conservative class of people to deal with, and has encountered many obstacles. She has shown herself ingenious, careful and receptive to a degree, and at the same time possessed of an enthusiasm and an unlimited perseverance which are calculated to overcome all obstacles. She has studied many of the English crop enemies *de novo*; she has popularized the work of other English entomologists, and has made accessible to the agricultural class the work of John Curtis and Prof. Westwood, and has adopted, and strongly advocated the adoption of, measures found to be successful in other countries, particularly in America. The good which Miss Ormerod has accomplished can hardly be estimated at the present time, but she will deserve, at the hands of posterity, canonization as the patron saint of economic entomology in England.

Aside from her annual reports, Miss Ormerod has published a large work entitled, Manual of Injurious Insects and Methods of Prevention, and numerous smaller works, treating of the Hessian fly, sugar cane insects and the injurious insects of South Africa, the last two being devoted to the agricultural interests of the English colonies.

* We regret that our space will not permit us to publish the whole of Mr. Howard's address. We are reluctantly compelled to omit his account of the work in foreign countries.—Ed.

Within the year the Royal Agricultural Society has made the office of consulting entomologist, or rather zoologist—for they have broadened the term—a salaried one, and Mr. Cecil Warburton, an able student of zoology, although not known as an entomologist, has been appointed to the position. Mr. Warburton has published one report, which is mainly compiled and devoted to extracts from the correspondence of the society, but it is too early as yet to judge of his capabilities from our standpoint.

Miss Ormerod's legitimate predecessor may be said to have been John Curtis, who, from the beginning of Dr. Lindley's *Gardener's Chronicle* contributed an important series of essays upon injurious insects to its columns, under the *nom de plume* "Ruricola." Mr. Curtis's connection with this famous agricultural journal was of great advantage to him, as it enabled him to secure information and specimens from all parts of the kingdom. He had also accumulated a large amount of information during the twenty years he was engaged in writing his great work upon British entomology. When the Royal Agricultural Society of England was founded, in 1840, the council of the Society invited Mr. Curtis to prepare a series of reports upon the insects affecting various crops cultivated in Great Britain and Ireland, and in the Journal of the Royal Agricultural Society for the years 1841 to 1857, he published a series of sixteen such reports The matter of these reports, and also of his previously published *Gardener's Chronicle* articles, was drawn upon largely for, and in fact forms the major portion of, his standard work upon Farm Insects, published by Blackie & Sons, London, Glasgow and Edinburgh, in 1860. Whether Curtis was remunerated for his work for the Royal Agricultural Society or not I am unable at this time to state, although he probably received some compensation. I learn, through the kindness of Miss Ormerod, that, chiefly on account of the value of his writings upon economic entomology, Mr. Curtis was awarded a pension from the civil list, which was augmented about three years before his death, on account of the sad loss of sight which he experienced.

In 1877 a strong effort was made to secure the appointment of a Government entomologist. A conference was held at the Society of Arts, which was largely attended and was presided over by the Duke of Buccleugh, K.G. The most important paper read was by Mr. Andrew Murray, and after a long discussion the conference resolved :

> That much of the loss occasioned by insects is preventable and ought to be prevented ; that it properly belongs to government to provide the necessary means for protecting cultivators from this loss, as it is only by simultaneous action over considerable districts that it can be effectually done, and government alone possesses or can obtain the requisite means of indorsing such action ; that the president and lords of the Council and the Agricultural Societies of the United Kingdom be informed of the opinion of this conference and urged to take the subject at once into their consideration, with a view to providing a remedy.

While we have no doubt that this conference was of sufficient importance and attracted enough attention to induce the president, lords, etc., to take the subject into consideration, no further action resulted.

Ireland.

Mr. George H. Carpenter was appointed in 1890 consulting entomologist to the Royal Dublin Society, and has submitted four reports, entitled, Report on Economic Entomology for the year 1890, and the same for 1891, 1892 and 1893. Reprints of these reports from the Reports of the Council of the Royal Dublin Society have been distributed Mr. Carpenter is assistant naturalist in the Science and Art Museum in Dublin, and I am not informed as to whether he receives special compensation for his work as consulting entomologist.

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India.

Among the English colonies the government of India stands out very prominently in the support which it has given to economic entomology. A most interesting account of the beginning and growth of this work has been transmitted to me by Mr. E. C. Cotes, from which I take, for the purposes of this paper, the following facts :

The present arrangement was the outgrowth of two reports, one on the wheat and rice weevil and the other on insecticides, which were drawn up unofficially in the early

part of the year 1888 by Mr. Cotes, at the suggestion of the secretary to the government of India, in the Revenue and Agricultural Department. Mr. Cotes was at that time in charge of the entomological collections of the Indian Museum, and the reports were published by the government, with the consent of the trustees of the Museum, as the first two numbers of an official series entitled Notes on Economic Entomology. The title of this serial was subsequently changed to Indian Museum notes, when the trustees of the Museum consented to charge themselves officially with the conduct of the investigation. The work really commenced in March, 1888, when Mr. Cotes was deputed to attend an agricultural conference at Delhi, where the part to be taken in the scheme by the various provincial governments was discussed. As a result of this conference the departments of land records and agriculture, attached to the various provincial governments, undertook to arrange for the submittal of reports and specimens from officials concerned with agriculture in all parts of India. The task of collating the results, and also of carrying on such investigations as could be conducted at headquarters, was intrusted to Mr. Cotes, aided by a staff of six office assistants, whom he was permitted to select. Circular letters were sent out to all parts of the country, and large numbers of reports and specimens soon began to come in. The results were published from time to time and freely circulated among all interested. One of the greatest of the early difficulties was the identification of species, but this was accomplished mainly through correspondence with specialists in different parts of the world. The results of six years of work are, in brief: The ascertaining of the identity of several hundred of the more important injurious species which affect crops in India. The recording of the nature of the damage occasioned by them, and the tracing out of the main facts in the life histories in a large number of cases. Information has been continuously supplied to officials and planters as to the nature of their insect pests and the most promising methods of treatment. Many experiments have been tried with a view to the adaptation of insecticides in use in other parts of the world to the requirements of special crops under cultivation in India. Fourteen numbers of the Indian Museum Notes, comprised in three volumes, have been published, and a number of special reports have also been sent out; one on the locust of northwest India, and one entitled Handbook of the Silk Insects of India. Two preliminary lesson sheets for use in native schools have also been prepared by the office. A thorough investigation of the insects affecting the tea plant is now in progress. The funds appropriated for the support of entomological investigation have varied from year to year; the only special grant for the purpose is one of 5,000 rupees per annum from the government of India. This is paid to the account of the Indian Museum, and forms a part of a general fund which is distributed at the discretion of the trustees, partly for the maintenance of the institution and partly for the support of the work carried on in various departments, one of which includes economic entomology. The work was at first looked upon in many quarters as a matter of comparative insignificance, but Mr. Cotes informs me that its importance is now very generally recognized, and that strong representations are being made in influential quarters, urging the desirability of extending the scope of the work, and making it, like other branches of research, an integral portion of the Agricultural Department of the government. The work which has so far been done by Mr. Cotes and his assistants has been admirable, and we know of no more interesting publication upon entomology than the Indian Museum Notes.

SOUTH AFRICA.

The *Agricultural Journal*, the official organ of the Department of Agriculture of Cape Colony, has been paying a great deal of attention to economic entomology during the last four or five years. The so-called Australian bug (*Icerya purchasi*), the grapevine Phylloxera, and the injurious locusts seemed to have roused the colonists to the necessity for more or less investigation, and the Agricultural Department has taken hold of the matter with some little energy. No distinctively official entomologist, however, was ever appointed. Privately Mr. S. D. Bairstow and one or two other colonists have made certain investigations, and their correspondence with Miss Ormerod, honorary consulting entomologist to the Royal Agricultural Society of Great Britain, resulted in the publication of Miss Ormerod's little book, entitled Notes and Descriptions of a Few Injurious

Farm and Fruit Insects of South Africa, with Descriptions and Identifications of the Insects by Oliver E. Jansen. Prior to the publication of this work Miss Ormerod published a leaflet entitled Observations on the Australian Bug, treating the insect from the South African standpoint. For several years, from 1889 to 1893, Mr. Louis Peringuey, an officer of the South African Museum at Cape Town, was employed as entomological adviser to the Department of Agriculture, and drew £100 per annum for his services. His duties in the Museum, however, did not permit him to devote anything like his entire time to entomological work, and in his advisory functions he chiefly answered questions as to the names of insects and the best remedies for insect pests. Acting upon his advice, the government attempted to stamp out the phylloxera by means of the bisulphide of carbon treatment, but without success, and he resigned his office in 1893. Since that time, and in fact for some time previously, the director of the Botanic Garden at Cape Town, Prof. P. MacOwan, a man of very wide information, although not a trained entomologist, has answered entomological questions for the government. His communications, most of them subsequently published in the *Agricultural Journal*, show him to be a clear-headed, practical man, and it is a pity for the interests of the colony that he is too much interested in his garden and botanical work to take up economic entomology as a study. Mr. MacOwan modestly writes, under date of April 11, 1894 :

> Unfortunately, I have been in the habit of reading everything that comes in the way and indexing it, so that really they consult my indexes. It is only thus, in the rough, practical way that a garden director, in a dozen years, gets some acquaintance with injurious and beneficial insects that I have answered questions of economic entomology. I only know what I have seen and fought against in the Botanic Garden, and anybody is welcome to such experience. . . . I only wish we could get some such man as seems to be raised easily in the States to do practical science work in the love of it.

Australia.

The Australian colonies of Victoria, New South Wales, Queensland, South Australia and Tasmania have all interested themselves to a very considerable extent in the subject of economic entomology. With an energy and receptivity to new ideas akin to our own, their agricultural societies and departments of agriculture have not been content to allow injurious insects full sway, but all have, in one form or another, made efforts to remedy the damage.

Tasmania. The earliest attempts were made in Tasmania nearly twenty years ago, when the Codling-Moth Act was introduced in the legislative assembly. The provisions of this Act were quite as wisely drawn as those of any subsequent injurious-insect legislation. It was not until 1891, however, that a definite council of agriculture was established by this colony, and not until 1892 that an official entomologist was appointed. In February, 1892, Rev. Edward H Thompson, a clergyman of the Church of England and a naturalist of very considerable attainments, who had made himself prominent in this connection by his writings for the local press, was appointed entomologist and pathologist to the Council of Agriculture. Authority for the appointment was given in section 13, clause 1, of the Council of Agriculture Act, and reads as follows :

> 3. To employ from time to time, with the approval of the governor in council, persons competent to give instructions of a practical character in matters pertaining to agricultural and horticultural science, and to arrange for occasional lectures on subjects of interest to cultivators of the soil.

Mr. Thompson's annual compensation was fixed at £300, which in 1894 was reduced to £270, in pursuance of a policy of general retrenchment. The entomologist has charge of no funds for expenses, and up to the present time has been allowed no assistants. Very considerable interest has been aroused, however, in the subject of economic entomology. Mr. Thompson has lectured upon insect pests throughout the colony, and during 1893 received nearly 1,500 letters of inquiry. A little volume of 100 pages, entitled Handbook to the Insect Pests of the Farm and Orchard ; their Life History and Methods of Prevention, Part I., has been published, and will be followed by others in the same line, provided the appropriations continue.

New South Wales In New South Wales there was started in 1890 an important publication under the Bureau of Mines and Agriculture, entitled *The Agricultural Gazette* of New South Wales. To this periodical Mr. A. Sidney Olliff, entomologist to the

Australian Museum at Sydney, has contributed many important articles on entomological subjects, which have resulted from his appointment to the charge of the entomological branch of the Department of Mines and Agriculture. Whether Mr. Olliff receives a separate compensation for his work in this direction from the Department, aside from his salary as an officer of the Museum, I have been unable to learn. The prominence given to entomological matters in the *Gazette*, however, is an indication of the live interest taken in the subject. In a series of entomological bulletins, begun in 1892, Mr. Olliff's name appears on the title page as "Government Entomologist, New South Wales." Another able entomologist is employed in the Technological Museum at Sydney, in the person of Mr. W. W. Froggatt, who has, under the "Technical Education Series" of leaflets, published at least one important paper bearing upon economic entomology, which has reference to the damage done to boots and shoes by *Anobium* (*Sitodrepa*) *paniceum*.

Queensland. In Queensland there is at the present time no official entomologist, although one of the best bits of printed matter relating to economic entomology which has been issued by any of the Australian colonies emanated from the Queensland Department of Agriculture. In 1889 there was published a report on insects and fungus diseases by Henry Tryon, who held, and probably still holds, the position of assistant curator of the Queensland Museum at Brisbane. This is a thoroughly practical and very able report, covering some 250 pages, and contains a great amount of important information. The report is designated as No. 1 upon this subject, but No. 2 has, unfortunately, not yet been published. The occasional bulletins issued by the Queensland Department of Agriculture, giving an account of the agricultural conferences held in different districts of the colony, show a very live interest in the warfare against insects, and this has been particularly the case since Prof. E. M. Shelton, an Englishman by birth, but since his early boyhood a resident of America, and long engaged in agricultural teaching and experimental work here, was employed by the Queensland government as instructor in agriculture in 1890. The Department has begun the publication of a series of bulletins giving the results of recent experiments made at the American agricultural experiment stations, edited by Prof. Shelton, in which late entomological information is given.

South Australia. The first work on injurious insects in South Australia was done by Mr. Frazer S. Crawford, a practical man of wide reading, who interested himself for some years before his lamented death in the study of insects and fungus pests. He read an important paper, under the title of "Insects and fungus pests," before the first congress of agricultural bureaus of South Australia in March, 1890, illustrating the paper by careful drawings done and engraved by himself. It is likely that, had Mr. Crawford lived, he would have been appointed official entomologist to the colony of South Australia. Since his death, however, a vivid interest in the subject has been kept up, largely through the interest shown in the matter by *Garden and Field*, an important agricultural newspaper published at Adelaide, the editor of which, Mr. W. C. Grasby, has visited this country, and is very appreciative of the work which has been done in the United States. The government viticultural expert, Prof. A. J. Perkins, is also a man of some entomological knowledge, although his researches have mainly been connected with the subject of insects injurious to the vine.

Victoria. In August, 1890, a conference was held at Melbourne, Victoria, with representatives from the board of viticulture, the council of agricultural education, the different horticultural societies, and wine and fruit growers' associations, for the purpose of considering means for the suppression of insect pests injurious to vegetation; and partly as a result of this conference and further agitation, Mr. Charles French was, in 1891, appointed entomologist to the government of Victoria, under the Department of Agriculture of the Colony. Mr. French's work is largely included in the two parts of an important handbook of the Destructive Insects of Victoria, the first part published in 1891 and the second in 1893. These reports are written in a popular style, and much attention is given to means of destruction. Their distinguishing feature, however, consists in their illustrations, which are colored, and many of which are very lifelike.

THE BRITISH WEST INDIES.

Injurious insects in the British West Indies have only recently received official or semiofficial attention, with the single exception that in the year 1801 a special commission composed of members of the general assembly of the Bahamas was appointed to investigate the damage done to the cotton crop by the red bug (*Dysdercus*, probably *suturellus*) and the chenille (*Aletia xylina*). Within the past two or three years, however, several of the islands have taken up the subject, with or without governmental support, and there is now a rapidly increasing spirit of investigation.

JAMAICA. In the appointment of Mr. T. D. A. Cockerell, a well-known entomologist, to the office of curator of the Institute of Jamaica, at Kingston, it was specially desired that the appointee should conduct investigations in economic entomology and answer all correspondence in this direction which might come in from planters. Upon taking charge of his new office, in June, 1891, Mr. Cockerell was immediately struck by the extraordinary abundance of scale insects in Jamaica, and their importance as enemies to many cultivated plants. With his accustomed energy he at once undertook the study of these insects, and has since published many papers about them, which have been contributions to knowledge. He started an interesting series of stylographic notes, mainly about injurious insects, disseminated much information on this subject among the planters, and fostered an interest in the study which it is to be hoped will not die out. He was succeeded in office in June, 1893, by Mr. C. H. Tyler Townsend, formerly an assistant in the Division of Entomology, U. S. Department of Agriculture, and entomologist to the State Agricultural Experiment Station of New Mexico, who, during the short time of his residence in Jamaica, followed in the lines laid down by Mr. Cockerell, and published a number of very interesting notes, both in the journal of the Institute and in the stylographic series of notes, which he continued. Mr. Townsend resigned in May of the present year, and we have not heard that his successor has been appointed.

LEEWARD ISLANDS. Although no officially designated entomologist is employed by the Leeward Islands, Mr. C. A. Barber, superintendent of agricultural for these islands, is a well-informed man, a trained botanist, and fully alive to the importance of entomological work. He has conducted some important investigations on the sugar-cane shot-borer and other sugar-cane insects, which have been published in the Leeward Islands *Gazette*.

TRINIDAD. No official recognition of economic entomology has yet been reached in this island, but a very active organization, known as the Trinidad Field Naturalists' Club, has been established, which is well worth mention in this connection, since its president, Mr. H. Caracciolo, and its secretary, Mr. F. W. Urich, have interested themselves especially in the subject of economic entomology and are laboring to interest the government. His Excellency the Governor occasionally attends the meetings of the club, and by the institution of prizes for essays and by similar means, a widespread interest in economic entomology is being aroused. The appointment of an official entomologist is probably a matter of only a short time. *The Journal of the Field Naturalists' Club* is an interesting periodical, full of entomological information, and is now in its second volume.

NEW ZEALAND.

New Zealanders have for some time been fully alive to the importance of the study of economic entomology. They have passed laws concerning the destruction of the codling moth and have made an effort to establish quarantine regulations against the introduction of infested substances from abroad. No governmental entomologist has been appointed, although the Department of Forestry and Agriculture published, in 1887, a monograph of the Coccidæ, by Mr. W. M. Maskell, registrar of the University of New Zealand, the title page of which reads: "An Account of the Insects Noxious to Agriculture and Plants in New Zealand." A second part of this account was promised in an introductory note, but has not appeared. Mr. Maskell has also written upon injurious insects in some of the New Zealand newspapers. Much credit is due to a corresponding member of this society, Mr. R. Allan Wight, of Auckland, for the public-spirited interest which he has

taken in economic entomology. Nearly every number of the *New Zealand Farmer* for several years has contained lengthy articles from his pen, and he has travelled a great deal for the purpose of lecturing before fruit growers' associations and other farmers' organizations. The editor of the *New Zealand Farmer* has also helped the good work along, and has published editorially a number of articles upon the subject. New Zealanders are agitating the question of the appointment of an official entomologist, but at this date seem to have little hope of immediate success.

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In Conclusion.

In concluding a review of this character, an American writer may perhaps be pardoned for an exhibition of national pride. Writing in 1870, Dr. A. S. Packard, in his first annual report upon the Injurious and Beneficial Insects of Massachusetts, compared the attention paid to economic entomology in this country with that which it received or had received up to that time in Europe, very much to our own discredit. In the twenty-four years which have intervened the change has been vast. All of the great advances in our science have come from America, and it may justly be said that, aside from the one department of forestry insects, the whole world looks to America for instruction in economic entomology.

These great advances, we must remember, would not have been possible without legislative encouragement. Activity on the part of workers and appreciation on the part of the people and their representatives have gone hand in hand. At the present time the amount of money expended for work in economic entomology is far greater in this country than in any other. Our regular annual expenditure in the support of entomological offices amounts to about $100,000, very nearly all of which is appropriated by the General Government, $29,000 going to the Division of Entomology of the Department of Agriculture and about $60,000 to experiment-station entomologists. To this amount must be added the large sums expended annually in publishing our reports and bulletins. The sum total thus reached will probably exceed the amount expended in this direction by the entire remainder of the world. Much more is therefore to be expected from American workers than from workers in other countries. The American members of this association must bear this fact in mind, and must realize that with the present rapid increase in interest among other nations nothing but the most energetic and painstaking work will result in the retention by the United States of her present prominent position. In some respects our results, have not been commensurate with our opportunities, but we have certainly justified in vast degree the money expenditure which has enabled us to prosecute our work. Not a year passes in which the sum saved to agricultural and horticulture, as the direct result of our work, does not amount to many times that which the Government appropriates, as has been often shown, and notably by our former president, Mr. James Fletcher, in his most able and interesting address at our Washington meeting in 1891.

In the good which has been accomplished in the way of remedial work against insects, the work of the official economic entomologists greatly exceeds that of all other classes of individuals. They have been investigators and teachers, students and propagandists: they have carried their researches into the fields of botany, bacteriology, chemistry, mechanics, and general zoology. Nearly all of the practical remedies in use to-day have been of their suggestion, and all great advances in recent years have come from their labors. Occasionally a practical agriculturist or horticulturist, unskilled in entomology, has discovered an important remedy, as was the case when Mr. J. S. Woodward sprayed his apple orchard with Paris green for canker-worms and found it to be a remedy for the codling moth: but Mr. Woodward would never have sprayed his trees at all but for the suggestion of Dr. LeBaron several years previously. And then, too, Prof. Cook, making the same discovery independently, was the one who, by his careful experiments, established public confidence in the remedy, and it is to him, more than to any one man, that the country to-day owes the great annual saving from the widespread adoption of this eminently practical remedy.

We have, then, done good work. We have accomplished results which have added greatly to the productive wealth of the world. We have justified our existence as a class. We are now better equipped for the prosecution of our work than ever before, and it may confidently be expected that the results of the closing years of the century will firmly fix the importance of economic entomology, in the minds of all thinking men of all countries.

On motion of Dr. Lintner, the thanks of the society were unanimously extended to the president for the admirable address presented.

A letter from the secretary, Mr. Gillette, announced that he would be unable to attend the meeting.

The following active members were elected:

F. C. Test, C. E. Chambliss and H. C. Hubbard, all of the Department of Agriculture, Washington, D. C.; Victor H. Lowe and F. A. Sirrine, of Jamaica, N. Y.; and F. W. Raine, of Morgantown, W. Va.

The following persons were elected to foreign membership:

Walter W. Froggatt, Technological Museum, Sydney, N. S. W.
Charles Whitehead, Barming House, Maidstone, Kent, England.
Geo. H. Carpenter, Science and Art Museum, Dublin, Ireland.
Dr. Geza Horvath, Ministry of Agriculture, Buda Pesth, Austria.
Prof. A. Targioni-Tozzetti, R. Staz. d. Entom. Agric., Firenze, Italy.
Prof. A. Giard, 14 Rue Stanislas, Paris, France.
M. J. Danysz, Laboratoire de Parasitologie, Bourse de Commerce, Paris, France.
Dr. J. Ritzema Bos, Wageningen, Netherlands.
Mr. Sven Lampa, Entomologist, Dep't. Agric., Stockholm, Sweden.
Dr. N. Cholodkowsky, Institut Forestier, St. Petersburg, Russia.
Dr. K. Lindemann, Landwirthschaftliche Akademie, Moscow, Russia.
Prof. A. Portschinsky, Bur. Entom., Ministère de l'Agriculture, St. Petersburg, Russia.
Mr. E. C Reed, Baños de los Cauquenos, Chile.

Mr. J. B. Smith, New Brunswick, N. J., presented the following paper:

BISULPHIDE OF CARBON AS AN INSECTICIDE.

By J. B. Smith, New Brunswick, N. J.

Bisulphide of carbon as an insecticide of very limited range has been known for many years; but for ordinary field crops it has not been in general use. In the 1893 meeting of the Association of Economic Entomologists, Prof. Garman mentioned that he had used it in the garden, covering melon vines with a tub and allowing a quantity of the bisulphide to evaporate, destroying thereby the aphides infesting the vines. This interested me greatly, because the melon louse, (*Aphis cucumeris*, Forbes,) is at times a most destructive pest in parts of New York and New Jersey, and one of the most difficult to deal with, owing to the fact that the leaves are close to the ground and that they curl as soon as seriously affected, making it simply impossible to reach them all, even with an underspray nozzle. A lot of pot-grown plants becoming badly infested with aphides in the botanical laboratory, I made a series of experiments, which were not recorded, but which determined that the liquid evaporated slowly, that it killed plant-lice very readily, and that it killed plants with equal facility if used in any large quantity. The appearance of the lice on cantaloupe and citron melons in New Jersey gave me an opportunity of making experiments, and Mr. Howard G. Taylor, of Riverton, N. J., kindly permitted me to kill as many hills as might be necessary to carry them on. I procured a dozen wooden bowls thirteen inches in diameter and six inches deep, inside measurement, and a series of small, graduated tumblers, in which "1 teaspoonful" and

"1 dram" corresponded. To get at the rate of evaporation I poured 1 dram into a graduate and left it exposed; but placed in a shaded spot. It required fifteen minutes to disappear completely. Eleven badly infested hills were then covered by bowls, the vines being crowded under when necessary, and 1 dram in a graduate was placed under each. At the end of twenty minutes I lifted one bowl, found that less than half the material had evaporated; that all the Coccinellidæ were dead, the small lice dying, and the Diabrotica, ants, and large viviparous aphides were yet all alive. Ten minutes later there was little change. At the end of three-fourths of an hour, though scarcely more than half the liquid was gone, all save a few of the mature, wingless, viviparous females were dead. In one hour there was yet liquid in all the graduates; but all the aphides were dead, or appeared so. To test the matter, all the hills treated were marked to be examined later. Another series of infested hills were selected; but the experiment was varied by using 2 drams of bisulphide in some cases, using a shallow saucer in others, pouring the liquid on the ground in two cases, and covering other hills with large square boxes, some of them anything but tight. All coverings were left on for one hour, undisturbed. Examined first a square box covering a shallow saucer with two drams of bisulphide; found this all evaporated and every aphis killed. The bowls covering the saucers in which 1 dram was used showed like results. Two square boxes which were not tight, covering graduates with 2 drams of liquid, had all insects unaffected and the material scarcely half gone. The two bowls under which the bisulphide was poured on the ground were then lifted and all the aphides were found dead. All the other hills covered by bowls showed all the lice dead and not all the bisulphide evaporated. The hills first treated were again examined and there was no sign of recovered life anywhere visible. Bowls, graduates and bisulphide were left with Mr. Taylor, and all the treated hills were marked for later examination and to note the effects of the chemical. The experiments were made in the middle of a very hot day, the thermometer 93° in the shade, little or no wind blowing, and the sand so hot that it burned through shoe soles and could scarcely be handled more than a few moments at a time. Many of the hills showed the edges of the leaves, when the covers were removed, yellowed and set with numerous drops of a clear liquid. I feared permanent injury, but instructed Mr. Taylor if he found that the plants died to continue his work before the sun was high or after it was quite low. He wrote me under date of July 19: "The hills you treated when here last started to grow nicely, except the two hills where the carbon was poured on the ground; that killed them. The treated hills showed no lice at last examination." I am quite satisfied, from the experiments above recorded and from others that were not recorded, but were simply made to settle practical questions, that in melon fields at least bisulphide of carbon can be used satisfactorily and effectively. It has the enormous advantage of reaching everything on all parts of the plant, not a specimen escaping. With a stock of from 50 to 100 light covering boxes about 18 inches in diameter, as many shallow dishes, and a bottle of bisulphide the infested hills in a field can be treated in a comparatively short time.

The paper was discussed by various members, Mr. Southwick describing a combination of bisulphide with "Polysolve" which he had used in the form of an emulsion; and Mr. Lintner suggesting the use of cloth coverings in place of the boxes employed by Mr. Smith. Mr. Galloway suggested the use of the protection cloth used by seedsmen, which is treated with oil and is practically air-tight; Mr. Howard referred to the original suggestion by Garman, of the use of a wash-tub, which was thought to be very satisfactory for limited applications; and Mr. Smith and Mr. Saunders suggested the use of paper caps, similar to but smaller than, those used by farmers for the protection of the hay crop. The subject of the relation of parasites to the control of the louse was also discussed, as well as the effect of the bisulphide on the plants themselves, also upon the germination of seeds, when employed for the eradication of grain pests, etc.

AFTERNOON SESSION—AUGUST 14TH, 1894.

The report of the committee appointed last year, on co-operation among station entomologists, was presented by Mr. Smith, in the absence of the chairman. The report covered the matter of concerted work upon the life-history of special insects and their geographical distribution, the selection of certain groups of species to be studied from year to year, co-operation in experimentation with insecticide machinery to avoid duplication, and suggestions in the matter of securing conjoint legislative action among the States. The report was accepted and ordered to be printed, so that opportunity might be afforded members to examine it, in order to be able to take definite action on its adoption at the meeting of 1895.

A letter from Miss Eleanor A. Ormerod was read by the President, in which she expressed her regret at being unable to be present at the meeting.

A paper by Mr. J. M. Aldrich, on spraying without a pump, was read in his absence by Mr. Davis. This paper described a scheme for the mechanical mixture of water and oil by the use of an ordinary Nixon climax nozzle, the combination of water and oil being made in the nozzle itself.

In the next paper Mr. C. L. Marlatt gave a review of a number of experiments conducted during the present year with several standard insecticide mixtures, also a series of experiments testing certain of the more important new insecticides or substances which seem to be of value as insect destroyers recently put before the public. The work was mainly to determine (1) the best methods of treating scale insects, (2) the effect of various mixtures on trees and foliage, in both summer and winter applications, (3) to show the relative merits of the old insecticides compared with some of the newer ones, and (4) the possibility of successfully combining insecticides and fungicides.

The paper was discussed by Messrs. Smith, Galloway and others.

Professor Galloway followed with a paper on various insecticide substances with which he had been experimenting for a number of years past, many of them in lines which had not hitherto been worked to any extent. He discussed particularly the kerosene emulsion made with lime, with resin wash, and the Bordeaux mixture. He also described a new method of making resin wash devised by one of his field agents in Florida, which, briefly, consisted in using purer caustic soda, causing a much more rapid formation of the resin soap. Various other mixtures of possible insecticide value were also suggested. The paper was accompanied by the exhibition of a large series of vials illustrating the various mixtures and combinations described by the author. The communication was generally discussed, and the important point emphasized that none of the emulsions were as perfect or as permanent as the standard milk and soap emulsions in common use, although some of them are possibly of value for immediate application.

In the absence of the author the following paper by Mr. Webster was read by the secretary :

SPRAYING WITH ARSENITES *vs.* BEES.

BY F. M. WEBSTER, WOOSTER, OHIO.

At the Rochester, N. Y., meeting of the association, I gave the results of some experiments looking toward a solution of the problem, "Will spraying fruit trees while in bloom affect the bees which afterwards visit these trees for the purpose of securing either honey or any other substance carried to the hives, and if such be the case, what is the effect upon the inmates of such hives?" The results of my first attempt at settling this question will be found on record in Insect Life, vol. v, pp. 121-123, and it will, therefore not be necessary for me to repeat them here. On account of the meteorological conditions under which the experiments were carried on they have never been deemed conclusive in point of definite results, even by myself, and I have only been waiting a favorable season in order to finish the work. This year the time appeared to have arrived in which I might hope to solve the problem.

On May 2nd two apple trees in full bloom—and the blossoms were abundant—were thoroughly sprayed with a mixture of 1 ounce of Paris green to each 12 gallons of water. After the water had evaporated the poison could be clearly observed both on bloom and foliage. The application was made during the forenoon, the day being warm and clear, and during the afternoon quite a number of bees were caught while visiting the bloom and marked with carmine ink. The hives were located but a few yards distant from the trees, and both being situated at a considerable distance from any other trees at that time in bloom. None of these marked bees were afterwards found dead about the hives. During the night following the application there was a rainfall of 0.20 inch. On the following day bees were caught and killed by being dropped into a cyanide bottle where the cyanide was embedded in plaster of Paris, after the usual custom. As soon as the bees were dead they were dissected as follows: The posterior legs with pollen attached were severed from the bodies and placed in a small glass vial and securely corked. The contents of the abdomens, including the honey sacs, were next dissected out and placed in a separate vial, and the same mode of procedure was followed with the whole inside of the thorax, this giving me the entire bee except the head, anterior and middle legs, wings, and chitinous walls of the thorax and abdomen. Besides these a number of the bees were kept intact. The whole series was submitted to the assistant professor of chemistry of the Ohio State University, L. M. Bloomfield, to be tested for arsenic by the Marsh method. Mr. Bloomfield found the weight of material submitted in each case to be as follows: Posterior legs, with pollen attached, 0.3498 gram; contents of abdomens and honey sacs, 0.0990 gram; ditto thorax, 0.0710 gram. After the usual tests to prove the absence of arsenic in the reagents it was found that no arsenic was associated with the posterior legs or the pollen with which they were loaded, none had been left in the thoracic matter, but the material from the abdomens gave unmistakable proof of the presence of arsenic. The entire bodies of a number of the bees, taken at the same time from the same tree, were then washed with diluted ammonia water, three washings failing to give a trace of arsenic, but the bodies, after being thus treated, and being boiled in water slightly acidulated, gave distinct traces of the poison, thus eliminating any possibility of the poison having been introduced into the abdominal matter at the time of dissection and from the exterior. May 15th a crabapple tree (*Crataegus*) was sprayed with a mixture of the same ratio of Paris green as before, but in this case only the contents of the abdomens were retained. This matter, to the weight of 0.1463 gram, treated as in the preceding, gave unmistakable proof of the presence of arsenic.

Just at this stage of my investigations, chance, if such a thing there be, threw in my way still more conclusive proof. A few days prior to my last experiment, probably about May 10th, a small apple orchard on the experiment farm was sprayed with Bordeaux mixture, to which had been added Paris green at the rate of 4 ounces to each 50 gallons of the mixture. The bloom had at this time nearly all fallen from the trees the exceptions being an occasional belated cluster. Three colonies of bees, recently brought on to the premises, were located near by, to all appearances in a perfectly healthy condition. A few days after the application of the poisoned Bordeaux mixture one colony suddenly became extinct and a second greatly reduced in numbers, dead bees being abundant about both hives. From these colonies I was able to secure dead bees, and both honey from uncapped cells and dead brood from the hive that had been so mysteriously depopulated. When tested for arsenic by Mr. Bloomfield, precisely as with the other matter, contents of abdomens of the dead bees to the amount of 0.2331 gram revealed the presence of arsenic; 3.7061 grams of honey gave no trace of poison, while 1.8481 grams dead brood showed it to be present, and the entire bodies of the dead bees, thrice washed in ammonia water, as before explained, gave traces of arsenic. In regard to the honey I can only say that it was from uncapped cells, which might and probably did contain last year's honey that was still being used for a partial food supply by the bees.

Briefly recapitulated, arsenic was found present in the contents of the abdomens of bees frequenting recently sprayed blossoms, and we are at least free to assume that more or less of it was contained in the honey sacs. The dead bees three times washed in ammonia water, the latter not revealing the presence of arsenic externally, when tested

showed its presence internally. Brood from uncapped cells (larvæ) of a colony suddenly dying without other apparent cause gave evidence of having died from the effect of arsenic which could have been introduced only from without.

In summing up the matter, then, I can see no other conclusion that can be drawn from the results of my experiments than that bees are liable to be poisoned by spraying the bloom of fruit trees, the liability increasing in proportion as the weather is favorable for the activity of the bees, and that all bloom must have fallen from the trees before the danger will have ceased.

Finally, I believe we now have the first conclusive proof of the effect on bees by the use of arsenical poisons in the orchard while the trees are in bloom. Heretofore all has been uncertainty, the statements made being based on either pure assumption, or, as in one instance, on the result of penning up bees and feeding them on poisoned sweetened water. It is certainly to the credit of the entomological fraternity of America that among their number but few could be found willing to risk a positive assertion based on such slender and unreliable information, and I feel that I am fully justified in pointing out the fact that in the case of two of our fellow members, Dr. Lintner and Mr. Fletcher, in the face of the legislative bodies of their respective States, both refused to commit themselves to the extent of making positive statements either one way or the other.

Mr. Lintner said that his position hitherto had been that laws ought not to be passed on the subject unless it was amply proved that harm did result to bees; and even in that event, the relative interests of the bee-keepers and fruit-growers should be carefully weighed, since it has been showed by him that many harmful insects also visited the blossoms, and they would stand an equal chance with the bees of being poisoned by the arsenical mixtures.

Mr. Smith said that the bee-keepers would always have an advantage when it came to securing legislative action, because, while they represented a comparatively small number of individuals, they are well organized, and can secure action where the much larger body of fruit-growers would be powerless.

Mr. Southwick read the following paper:

ECONOMIC ENTOMOLOGICAL WORK IN THE PARKS OF NEW YORK CITY.

By E. B. Southwick, New York City.

The work of the entomologist of the Department of Public Parks in New York City is the care of trees, shrubs, and plants in an entomological sense, and is under the direction of the Commissioners.

The ground to be covered is about 4,000 acres more or less, but most of the work is confined to the Central and other parks of the city proper. Two men, with the entom-

Fig. 56.—The male moth.

Fig. 57.—(*a*) The wingless female, (*b*) a young larva,

Fig. 58.—(*c*) The male chrysalis, (*d*) the female.

ologist, constitute the working force, save when the Orgyia cocoons become very abundant, then laborers assist in their removal.

The work is continued the year round every day save Sundays and an occasional holiday. A one-horse spraying machine carrying $2\frac{1}{2}$ barrels of liquid is used for the or-

dinary work of spraying, and a one horse machine with a powerful force pump for knocking off plant-lice, cottony scale, etc. Various other tools and appliances are used for the removal of egg masses, webs, bag-worm, cases, larvæ, etc. The poisons used are those that are now quite commonly accepted to be the best, viz., London purple, Paris green, kerosene, crude petroleum, crude carbolic acid, bisulphuret of carbon, hellebore, pyrethrum, and others. The insect that requires the most attention the year round is *Orgyia leucostigma*. Fig. 56, the male moth; fig. 57, (*a*) the wingless female, (*b*) a young larva; fig. 58, (*c*) the male chrysalis, (*d*) the female. This species is reduced in several ways.

(1) By hand-picking, by which means barrels of the cocoons and egg masses are removed each year. This work is carried on through the entire winter, when all the parks have to be gone over and the trees put in as good condition as possible.

(2) By jarring the larvæ (fig. 59) down with a pole so arranged that a blow from a mallet on a projection placed at the larger end of the pole, will jar down any that may be on the limb.

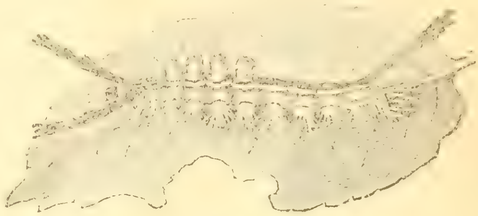

Fig. 59.

(3) By poisoning the foliage with London purple, which is quite effective, and used especially on very large trees that cannot be treated otherwise.

(4) By spraying the trunks of large trees that are covered with cocoons with an emulsion of petroleum and carbolic acid. This spray put on with force will penetrate most of the cocoons and destroy the pupæ or larvæ within, and many of the eggs that may have been deposited on the outside. This last method is only resorted to when we are unable to subdue them in other ways. Large quantities of the cocoons of this insect are collected each year and taken to the arsenal, where the parasites when bred are allowed to escape from the windows of the building to continue their work of parasitism.

The bag-worm, that at one time defoliated whole sections of the park, has been so subdued that it no longer gives us much trouble. Barrels of their cases have been removed from the trees, and each year we remove all that appear in devastating numbers as far as it is possible to do so.

The European leopard moth (*Zeuzera pyrina*) is one of the worst insects we have to contend with. It works in secret, and not until the damage is done can we locate it. Last season we spent two months on this insect alone, collecting and destroying the larvæ and pupæ. All the affected limbs were collected, the insects removed, and then the limbs were taken to the dump and destroyed by fire, in this way making the work complete. A great many wagon-loads were so collected and destroyed, and this work manifested itself this year in the lesser number of trees affected. This year we continued the work of collecting, but were only able to give two weeks to it, but with the aid of the gardeners we were able to destroy a great many. I believe the work we have done with this insect alone, has saved thousands of trees in our parks that would otherwise have been either destroyed or deformed. This question is a serious one when we are considering such valuable representations of our Silva as are collected in our city parks, for when a limb is amputated by this insect the stub is sure to die, and if the fungus does not immediately take possession of it, it will be amputated by a so-called gardener, who does not see the advisability of protecting the scar from fungi and insects; and here is offered a field for the greedy fungi, whose ever-present spores are ready to grow when the proper field offers itself, and they hardly ever fail to take possession, and all over, our fine elms can be seen with groups of *Agaricus ulmarius* in all stages of growth. This close pruning, without proper protection from insects and fungi, is one of the most important questions of our times, for every year great numbers of trees are destroyed for want of proper protection and a knowledge of seasonable pruning.

Right here the sap-fly, which I take to be *Mycetobia pallipes*,* finds congenial habitat, and hundreds of trees are weakened by the flow of sap they cause, besides being unsightly from the slimy frass running down their sides. Those we treat with a crude carbolic-acid emulsion sprayed over them ; after a time, however, they again show themselves, and have to be treated again.

The elm leaf-beetle is another pest that we have to fight, but with the force of two men, and miles of ground to cover, it is very difficult to keep this insect in subjection. Our success has been in preventive measures rather than otherwise. However, we do successfully destroy them when they have spread over the entire tree. As soon as the first eggs are discovered on the leaves, about the 1st of June, we immediately poison the foliage and keep them from spreading. When the larvæ come down to pupate and collect at the base of the tree, we treat them by spraying with an emulsion of kerosene and crude carbolic acid. In this way we destroy bushels of them, and with the spraying are able to keep them in check in our city parks.

The pine Chermes (*Chermes pinicorticis*) is another insect that is giving us a great deal of trouble, but we can subdue it most effectually with a stiff spray. The tree is then treated with the kerosene emulsion, and also those insects collected or washed down around the base of the tree. This has to be done at least three times a year. For the past seven years I have been using the stiff spray for different work, and it is one of the best means I know of for cleaning maples of Pulvinaria. Three years ago *Pulvinaria innumerabilis* was very abundant on a great number of trees in our parks, and I treated them with the hose and emulsion until I had them in fair subjection. The Chermes and Pulvinaria were at one time taken off with corn brooms, but the spray is much more effectual, and gets in among the small twigs without breaking them.

Scale insects are treated with washes and taken off with steel brushes, and are also sprayed with an emulsion, which covers the smaller branches. *Eriosoma Rileyi* is common on our young elms, and these are treated with the kerosene and carbolic emulsion.

The larvæ of the larger silk producers are collected and destroyed, as well as the cocoons. Datanas are collected by hand, as they are assembled in masses, and destroyed. The web-worm, always abundant in our parks, is collected either by taking down the twigs or, if the tree is a valuable one, by twisting them out and crushing the larvæ.

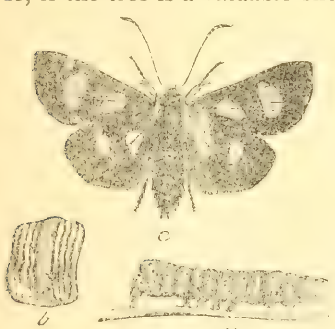

Fig. 60.—(*a*) The caterpillar, (*b*) a segment showing markings, (*c*) the moth.

Alypia octomaculata, fig. 60, (*a*) the caterpillar, (*b*) a segment showing markings, (*c*) the moth), is abundant where Ampelopsis is grown. These are effectually destroyed with the London purple solution.

The catalpa trees have been affected by a species of Cecidomyia, which causes the ends of the branches to turn black and break off. These are collected every year and destroyed before the larvæ leave the twigs. Leaf-skeletonizers are always abundant on many of our trees, and the Platanus and Liquidambar species have suffered most. These insects are cut off as soon as they can be seen working and destroyed. If left for any length of time they make the tree very unsightly.

Aphis species are treated with the kerosene emulsion after the colonies have been broken up with the stiff spray. I have found it impossible to get an emulsion to act upon many of the plant-lice on account of the secretion ; but let me play the hose on them a short time and they are disintegrated and demoralized, and many are killed outright by the shock ; then a fine spray of emulsion will reach them more effectually than otherwise. The more I have occasion to use a force of water the more I see the benefits that will accrue from it, especially in economic entomological work, for larvæ of many kinds can be knocked down by it, and my men have brought me birds that they have knocked out of a tree and captured.

*Mr. A. D. Hopkins says it is probably a species of Sciara.—E. B. S

Other insects that are working on the foliage and in the stems of our plants we have in great numbers, but enough has been said to give an idea of some of the work we try to accomplish. Could we have sufficient force to do the work at the proper time there seems to be no reason why our parks could not be kept in the best condition; but with a force of but two men, with the entomologist, the wonder is that even a respectable showing can be made and the vegetation kept in as good condition as we now find it.

Mr. Howard said that he was very much interested in Mr. Southwick's account of the use of water as an insecticide and referred to some experiments in the same line which he had conducted, in which he showed a strong stream of water to be an effective agent against the rose slug and certain other insects.

Some discussion followed on the nature of the work and the probable species of the sap worm described by Mr. Southwick, which was thought by Mr. Lintner to be probably a species of Sciara.

Mr. Southwick followed with a second paper on the Wood Leopard Moth in the parks of New York, giving an historical account of the insect, its present status, the nature of the injury, the plants affected, and the means he had adopted to exterminate the pest. He stated that this is a most difficult insect to control, and could only be reached by cutting off the affected limb. In the case of rare trees, he had adopted the plan of putting a little bisulphide of carbon in the larval burrow with an oil can, closing the entrance with putty, which had proved an effective remedy.

The paper was discussed by Messrs. Smith, Howard and others.

In the absence of Prof. F. H. Snow, of Lawrence, Kansas, his paper was read by Mr. Victor H. Lowe, This communication, entitled "Work in Economic Entomology at the University of Kansas for the season of 1894," related particularly to the successful work with the chinch bug disease (*Sporotrichum globuliferum*), and a new alfalfa and wheat pest, which proved, on rearing, to be *Agrotis introferans*, Grote.

Mr. Smith reported that the same noctuid had been found by Mr. Gillette to occur very abundantly the present year in Colorado, and Mr. Howard referred to the occurrence of the moth in enormous numbers in Nebraska.

Messrs. Ashmead, Lintner and Hopkins were apppointed by the President a committee to nominate officers for the ensuing year.

MORNING SESSION—AUGUST 15TH, 1894.

Mr. Hopkins presented notes on some discoveries and observations of the year in West Virginia. The paper dealt chiefly with wood-working insects, but also covered various garden pests, such as the potato-scab gnat, the melon plant-louse, etc. The paper was discussed at some length by Mr. Smith, Dr. Lintner, Mr. Raine, and others.

The President read a letter from Mr. Webster, stating that he was unable to be present on account of being actively engaged in stamping out an attack of Fidia larvæ on grape roots, by the use of bisulphide of carbon.

Mr. Howard read a paper on the eastern occurrences of the San Jose scale, in which he briefly reviewed the history of the insect in the United States and showed that as a result of investigations during the winter of 1893-4 and the summer of 1894, the scale has been discovered in six localities in the eastern United States outside of New Jersey, while in the latter State it occurs at many points. He traced the introduction to two nursery firms in the state of New Jersey and one in Missouri. He detailed in full the remedial work which has been undertaken by the Division of Entomology of the United States Department of Agriculture in each of the six eastern localities, and showed that by virtue of the active measures which have been taken, the insect will probably be stamped out in the east by the close of the season.

The next paper was on the same subject, and discussion was therefore deferred.

Mr. Smith then read a paper on the San Jose scale in New Jersey. He stated that the scale had first come to him from a nursery in the state in March, 1892, but had not been recognized and he did not become aware of the true nature of the insect until he received the special circular sent out by the United States Department of Agriculture early in 1894. He described his work in connection with the stamping out of the scale, and particularly the active and energetic steps taken by the owners of the infested nurseries, from which the scale had been exterminated on young stock. He reported sending out letters to all persons who had obtained stock from the nurseries in question, enclosing the circular from the Department of Agriculture referred to, and the examination of nearly 100 orchards in person. As a result of his observations and work, he felt confident that the scale would ultimately be completely stamped out. The introduction of the scale was shown to have been either in 1886 or 1887, on some plum stock claimed to be curculio-proof, obtained from the San Jose region in California. Other fruit trees imported from California were also shown to be very likely infested. He gave some facts in regard to the trees and varieties which are most liable to be infested, also some notes on remedies.

In the discussion of these two papers Dr. Lintner considered the possibility of the introduction of the scale on fruit from California and concluded that the likelihood of the scale, so introduced, obtaining a foothold, was very slight.

Mr. Marlatt thought there was danger in placing too much confidence in the work or the statements of nurserymen as to the completeness of the eradication of the scale, pointing out the great difficulty of thorough extermination and the ease with which a random scale here and there could be overlooked. Mr. Banks referred to the publication in a New York paper of occurrences of the scale in two or three localities in New York, accompanied with the report of the adoption of active measures to stamp it out in each instance.

AFTERNOON SESSION—AUGUST 15TH, 1894.

In continuation of the discussion of the morning session, Mr. Smith exhibited specimens of California pears, obtained in Brooklyn which were covered with the San Jose scale in all stages of development.

Mr. Lintner exhibited an apple coming from Ottawa, Canada, handed to him by Mr. Saunders which was covered with the scales of *Mytilaspis pomorum.* (Fig. 51.)

Mr. Davis read a paper on mealy bugs and other lice. He gave a careful resume of the life history of the common mealy bug (*Dactylopius destructor*) with detailed descriptions of the different stages, also some notes on *D. longifilis.* He also described a coccus which he found on roots of clover, giving a general account of the habits and careful descriptions of the species. He also referred to *Eriococcus azaleæ* and other scale insects.

The paper was discussed by Messrs. Sirrine, Ashmead and Howard. Mr. Sirrine thought Mr. Davis's clover coccus was the same as the one found by Professor Forbes on white clover, and named by him *Coccus trifolii*, Mr. Ashmead coinciding in this view, and Mr. Howard stating that the *Eriococcus azaleæ* was certainly not an introduced species from Belgium, as suggested by the author, since the species is not known in Europe, and Professor Comstock has found it on wild plants near Ithaca, indicating that it is undoubtedly a native species. He said also that the two old species of Dactylopius referred to by the author had been shown by Berlese to be synonymous with European species, and that their life histories had been worked out by this author in great detail.

Mr. Marlatt read a paper on the Pear-tree Psylla in Maryland, in which he described the sudden occurrence of this northern pear pest in two orchards on the eastern shore of Maryland, in very destructive numbers. The introduction of the species was shown to have been upon nursery stock from infested regions in New York, and the author was confident that the injury, while excessively severe for the moment, would not be of long duration, judging from the past history of the insect. A brief review of the life history was given, with some notes on the natural enemies, notably a species of lace-wing fly,

Chrysopa oculata, the larva of which feeds voraciously on all stages of the Psylla ; also various species of lady-birds which are useful in a similar way. The life history of the lace-wing fly was carefully worked out. Experiments with various insecticides on the eggs on the Psylla were detailed, and general recommendations for remedial work were given.

The paper was discussed by Messrs. Davis, Southwick, Lintner and others, both Messrs. Southwick and Lintner reporting cases of sudden appearance of the Psylla, with subsequent equally sudden disappearance.

Mr. Smith deferred speaking until the reading of his own paper which included a reference to the same insect, in which he said that the conditions described by Mr. Marlatt were identical with the conditioms obtaining in localities in New Jersey, and that the source of the introduction was also the same.

Mr. Smith then read a paper entitled "Notes of the year in New Jersey," which was a summary of the important insects brought to the attention of the entomologist during the present season. It contained references to occurrences of the Pear-tree Psylla, the Pear Blister-mite, the Pear Midge, a new pear pest in a species of Agrilus, probably *anxius*, the habits of this last insect being described at some length. The paper also considered the use of protective coverings for the trunks of trees as a means against the borer, invasions of cutworms, the Periodical Cicada, some potato insects, onion maggots, the remarkable mortality of the clover-leaf weevil larvæ, and the potato-stalk borer, *Trichobaris trinotatus*, which had been brought to his attention for the first time the present year. The paper was discussed by most of the members present.

Mr. Davis also presented a communication covering notes on special economic insects of the season in Michigan, referring particularly to the occurrence of *Diplotaxis Harperi* as a strawberry pest, a dipteron raspberry girdler, *Adimonia clavicollis* as a cherry tree defoliator, *Notoxus anchora*, as feeding on fruit of cherry.

In the discussion Mr. Hopkins stated that he had found the raspberry cane maggot described by Mr. Davis, in the Alleghany Mountains in 1892, but did not rear the adult.

In the absence of Mr. Chittenden his paper entitled "Supplementary Notes on the Strawberry Weevil, its Habits and Remedies," was read by Mr. Southwick. The writer noted the occurrence of the strawberry Weevil, (*Anthonomus signatus*, Say) in more or less injurious numbers in parts of Maryland, Virginia, Delaware, Pennsylvania, and New Jersey in 1893 and 1894. Three new food plants were discovered, the red-bud (*Cercis Canadensis*), the dewberry and raspberry and the life-cycle from egg to adult was found to extend over a period of four weeks. The methods of oviposition and of severing stems were described. A table showing by States the destructive appearances of the insects from 1871 to date is given. Under the head of remedies, the necessity of clean culture is pointed out, also the benefit that might be derived from early-blooming varieties of staminates, and of the red-bud tree as trap-crop. Kerosene emulsion and Paris green were found by experiment to be of service, but the latter gave the better results. Directions are given for the application of these insecticides, three or four sprayings being advised, beginning two or three days before first bloom. The subject of covering beds is considered, and, in conclusion, the fruit-grower is urged not to trust entirely to staminate varieties.

Mr. Smith said he had anticipated damage from this insect the present season, but so far as he had observed, it did not manifest itself in New Jersey.

In view of the lateness of the hour, the following papers were read by title only :

"Notes on the Insects of Northern Idaho," by J. M. Aldrich, Moscow, Idaho. This paper included a few notes on the principal pests of the "Pan-handle" district of Idaho, where the farming land is at an elevation of 700 to 3,500 feet, with a corresponding change in climate. The insects discussed were the Wheat Aphis, the Codling Moth, Bud Moth, Woolly Aphis, Pear-leaf Blister-mite, and the San José scale, which latter the author stated was the most dreaded insect pest, and a considerable effort was being made to prevent its spread to new localities.

"Insects of the Year," by F. M. Webster, Wooster, Ohio. Mr. Webster's paper had particular reference to the occurrence of the larvæ of *Fidia viticida*, Walsh, in vineyards, which was the important insect manifestation of the year in Ohio. It also covered the raspberry Agrilus, the strawberry Weevil, the pear tree Blister-beetle, joint worms, the Bean Leaf-beetle, and other garden and small fruit pests, such as the Grain Louse, Corn Bill-bug, and a Thrips, which is proving very destructive to onion crops. Other insects were also mentioned briefly.

"Notes from New Mexico," by T. D. A. Cockerell, Las Cruces, N.M. This paper covered numerous short notes on various insects observed in New Mexico, with a description of the climatic and other conditions characteristic of the more important natural districts of the State, and the bearing of these on the insect fauna.

"Some Experience with Mosquitoes," by Howard Evarts Weed, Agricultural College, Miss. This communication covered the result of certain experiments in the use of kerosene as a means of preventing the breeding of mosquitoes in water reservoirs on the college campus. The use of kerosene was very satisfactory, and resulted in a very marked subsidence of the mosquito trouble. The author also reports that kerosene is a very good preventive to apply to the hands or face in the case of mosquito outbreaks.

The report of the committee on nominations was presented by Mr. Lintner as follows:

President—J. B. Smith.

Vice-President—C. H. Fernald.

Secretary—C. L. Marlatt.

The report was unanimously adopted and the officers named duly elected. (By inadvertence no second vice-president was nominated or elected.) It was decided to follow the usual custom for the next meeting, and hold it on the two days preceding the meeting of the American Association for the Advancement of Science, and at the place decided upon for the next meeting of that Association. On motion, it was requested that the minutes be printed in full in "Insect Life."

After the reading and approval of the minutes of the entire session, Mr. Southwick moved that the thanks of the Association be tendered to the President and Secretary for the able and satisfactory manner in which they had discharged their respective duties. The resolution was adopted.

The Association was then declared adjourned by the President for one year.

PROFESSOR C. V. RILEY.

Every entomologist in North America will, we are confident, join with us in the expression of the deepest regret, that Professor C. V. Riley has felt compelled, owing to the impaired state of his health, to resign his position as Entomologist of the United States Department of Agriculture. The admirable work that Dr. Riley and his staff have accomplished, both in scientific and economic entomology, during the many years that he was Director of the Division, is so well and widely known that it is unnecessary to enter into any details here. There are few who possess, in so eminent a degree as Dr. Riley, scientific ability, accurate knowledge, painstaking industry, and acute powers of observation; these gifts and attainments have been abundantly manifested in the immense additions that he has made to the knowledge of insect life in all its various phases, and it would be a calamity indeed if they were withdrawn from active exercise. It is gratifying, then, to know that Dr. Riley will retain the honorary Curatorship of the Department of Insects in the United States National Museum at Washington, and that he will now devote himself to some long contemplated work of a purely scientific character. We earnestly trust that the relief from the cares and anxieties of administrative work in a Government office will speedily restore his health and strength, and that we shall see the fruits of his labors during many a year to come.

While we deplore Dr. Riley's resignation, we cannot refrain from expressing our gratification at the appointment of his successor. The authorities at Washington have shown their wisdom in conferring the vacant office upon Mr. L. O. Howard, who has been so long and so ably sharing in its duties as First Assistant. The Department is certainly to be congratulated upon having at hand a skilled and learned entomologist who possesses in every respect the varied qualifications necessary for the successful performance of so important an office. We have every confidence that the world-wide reputation now possessed by the Division of Entomology at Washington will be in no wise impaired under the administration of Mr. Howard, and we heartily wish him health, strength, and a long life for the successful performance of his arduous and important duties.—*C. J. S. B.*, *Canadian Entomologist*, June, 1894.

BOOK NOTICES.

THE BUTTERFLIES OF NORTH AMERICA: By W. H. Edwards. Third Series. Part XIII.

Another part of Mr. Edwards's magnificent work has been received, and is of particular interest to Canadian students. The three beautiful plates represent the following: Plate I., *Neominois Ridingsii*, Edw. The upper and lower sides of both sexes of the early and late forms are shown, together with the egg and pupa, and a full series of enlarged drawings illustrating the larva in all its stages. This is a Coloradan insect, and flies in the mountains at an elevation of from 5,000 to 8,000 feet. Up to the present there is no recorded instance of *N. Ridingsii* having been taken in Canada.

Plate II. shows *Chionobas Æno*, Bdl., male and female, and a variety of the male, as well as *Ch. Æno*, var. *Assimilis*, Butler, and the egg of *Crambis*, Freyer. *Æno* is an arctic species occurring with the variety in Labrador, and also in Colorado where it inhabits the loftiest mountain peaks. An interesting account of its habits is given from the notes of Mr. David Bruce, who has done a great deal to work up the life-histories of the butterflies of the Coloradan mountains. *Æno* belongs to the *Semidea* group of the genus, and has been confounded with that species and *Crambis*, Freyer. Mr. Edwards says: "It was not till Mr. Bruce explored the peaks of Colorado that it became possible to understand what *Æno* was, and the limitation of *Brucei* made clear the position of *Crambis*."

The series is now arranged as follows:

1. CRAMBIS, Freyer.
2. BRUCEI, Edw.
3. ÆNO, Bdl.
   ——— var. ASSIMILIS, Butler.
4. SEMIDEA.
5. SUBHYALINA.

Ch. Also, Bdl., Mr. Edwards rejects altogether as an American species.

Plate III. shows *Ch. Macounii*, the grand species which was discovered at Nepigon, north of Lake Superior, by Prof. John Macoun, of the Geological Survey, in whose honor it was named. *Ch. Macounii* belongs to a different group of the genus to the species mentioned above, and finds its place with *Californica* and some other large species occurring on the Pacific Coast. It is a fine insect expanding 2–2½ inches and has the remarkable feature of lacking the sexual band of androconia or special scales, which is such a striking characteristic of the males of all the other species in the genus. The plate is a very beautiful one, and shows a pale male and the full life-history with the exception of the pupa. The female figured, although of course copied from an actual specimen, is

hardly typical of that sex, and it is to be hoped that at some future time Mr. Edwards will publish another illustration showing the more usual form, which has a much richer appearance both on the upper and under sides.

Ch. Macounii is decidedly a variable species, both in the intensity of the golden brown of the wings, in the amount of infuscation along the nervures, and in the size and number of the ocelli. Both sexes frequently have three ocelli on the primaries, and occasionally four. One specimen in my collection, plainly a male, has four distinct ocelli on the primaries, the second and fourth from the apex large and pupilled. In fact, this specimen has more nearly the markings of what appears to me the typical form of the females. There is also a very much infuscated variation of the male which is rarely taken, in which the nervures, are all broadly bordered and the greater part of the surface of the disk is covered with dark scales. One of these was mentioned by Mr. Edwards in his original description (*Can. Ent.*, XVII., p. 74), and was omitted from the plate now published for want of space. The life-history of this species has not yet been worked out, as no one has succeeded in obtaining the pupa. It will probably be much like that of *Ch. Chryxus*: but for the present it is unknown, and it remains for some expert and patient breeder to carry the larvæ through all their stages and obtain this missing link. The eggs are easily obtained when a female has been captured; but the breeding is very tedious, the larval life lasting nearly two years. J. F.

MONOGRAPH OF THE NORTH AMERICAN PROCTOTRYPIDÆ: By William H. Ashmead. Bulletin of the U. S. National Museum, No. 45; pages 472; plates 18.

Every student of the Hymenoptera must be delighted at the issue of this magnificent volume, which bears most ample testimony to the extensive studies and patient industry of the author. Treating, as he does, of a family in which the American species had previously been but meagrely represented in collections, he has necessarily been compelled to describe a large proportion of the insects now recognized, and to erect a considerable number of genera for their reception. The labor involved in the critical examinations requisite for the determination and description of so many microscopic forms, and in the preparation of the voluminous text, must have been enormous, yet the author has been able to amplify and embellish his work by the delineation of some one hundred and fifty exquisite figures.

The position of the Proctotrypidæ in the order Hymenoptera is considered to be much more closely allied to some families of the Aculeata than to the Chalcididæ, with which they have been usually grouped, while they also approach in other respects the parasitic Cynipidæ. The Mymarinæ, hitherto included as a sub-family, are set aside as constituting a distinct family allied to the Chalcididæ, so that the species now contained in the Proctotrypidæ are characterized, and distinguished from the Chalcids, by the pronotum extending back to the tegulæ, and the ovipositor issuing from the tip of the abdomen. Ten sub-families are recognized, which contain about one hundred and thirty genera, represented by nearly six hundred species—a doubling of the genera and quadrupling of the species as enumerated in the catalogue of Hymenoptera issued a few years ago by Mr. Cresson. Many of the genera are known only by single species, but others contain numerous forms, the most extensive being Polygnotus (32), Proctotrypes (21), Prosacantha (27) and Telenomus (32). The synoptic tables requisite for the separation of the species in such genera, as well as the tables for the distinction of genera, etc., give evidence of great care and skill in their preparation and arrangement.

While many of the genera are apparently confined to the more southerly and westerly regions, the species in other groups have an extended range, which at times seems to be almost continental, as for instance *Proctotrypes californicus*, which has been taken at Ottawa. The members of this family have received but scanty attention in Canada, so that their distribution northward cannot be stated, but undoubtedly many interesting species could be found by a careful and patient collector in any locality. Provancher, in his Faune Entomologique, was able only to announce the occurrence of *nine* species, and about twice as many are recorded in his Additions completed just before

his death. Mr. Ashmead, however, has been able to enlarge the list of Canadian species to about ninety. With the exception of three forms from Vancouver Island, the species are all from a few localities in eastern Ontario and Quebec, so that the Dominion as a whole has been practically unworked. The three western species are *Mesitius vancouverensis* and *Polymecus vancouverensis*, collected by the Rev. G. W. Taylor, of Victoria (and communicated through the writer to Mr. Ashmead), and *Anteon puncticeps*, taken by Mr. Wickham.

Although the Proctotrypids are all small, and frequently microscopic, they show great variations in structure, and their study thus becomes very interesting. A large proportion of them are egg-parasites, while others prey upon Aphididæ, Cecidomyidæ, etc. In many species (noticeably in the sub-family Bethylinæ) the females differ largely from the males in the shape of the head, antennæ and structure generally. Those of the sub family Dryininæ have remarkable chelate, or pincer-like claws, on the anterior feet, which are probably for more firmly grasping, during oviposition, the small, active homopterous insects on which the larvæ are parasitic. Many forms are wingless or have very rudimentary wings, but they are, nevertheless, very nimble little atoms, and can leap many times their own length.

As the appearance of Mr. Ashmead's splendid monograph may stimulate some of our members to the collection and study of these insects, it may be stated that a considerable number of the species, such as Bæus, etc., may be obtained even in winter by sifting moss as it is done for small coleoptera. This habit of hibernating in the moss of swampy localities is another feature (not mentioned by the author) which separates them from the other hymenoptera known to me, with the exception, perhaps, of ants, which are also occasionally obtained in sifting. W. H. H.

THE BUTTERFLY HUNTERS IN THE CARIBBEES: By Dr. Eugene Murray-Aaron. New York; Charles Scribners' Sons, 1894; pp. 269.

It is a novel event in literature to have a boys' book of adventure written by an entomologist: we were, therefore, prepared to peruse with interest the volume which Dr. Murray-Aaron has just published. Belonging, perhaps, to those whom he characterizes as the "younger old people," we were charmed beyond measure with the book and read it through from beginning to end with as much avidity and enjoyment as any adventure-loving school-boy. It relates, in pleasant easy style, the expedition made by a couple of boys under the guidance of their naturalist friend "the doctor." During the early winter months they visited several of the islands of the Bahamas, and then made a more venturesome excursion across Haiti and into Santo Domingo, winding up with a flying visit to Jamaica. Their object was to collect butterflies especially, and at the same time to gather all the animal and vegetable curiosities that they conveniently could. For an account of their success and the various "dodges" they had recourse to, especially when in pursuit of *Papilio Homerus*, we must refer the reader to the book itself. It is not, however, a mere record of the doings of collectors; a great deal of interesting information is given regarding the condition of the negro races in their barbarism where left to themselves, and their happy condition when under British rule. Much pleasant instruction may also be gained regarding the geography, scenery and government of the various islands that were visited. If any paterfamilias is looking for a book to put in his boy's Christmas stocking, he cannot do better than purchase a copy of this; if his boy has any taste for natural history it will delight him beyond measure. The book is handsomely printed and bound, and illustrated with several well-executed plates. The entomologist may be disappointed at the absence of lists or names of species and pictures of butterflies, but the book is not meant for a scientific treatise, though its statements may be relied upon as strictly accurate, the author being well-known as the editor for a time of *Papilio*, and Curator of the American Entomological Society at Philadelphia, as well as a valued contributor to the *Canadian Entomologist*. C. J. S. B.

RANDOM RECOLLECTIONS OF WOODLAND, FEN AND HILL; AND WOODSIDE, BURNSIDE, HILLSIDE AND MARSH: By J. W. Tutt, Editor of the *Entomologists' Record and Journal of Variation.* London: Swan, Sonnenschein & Co.

The name of the author of these two volumes must be familiar to our readers as an occasional contributor to our pages, while he is widely known as a writer of much scientific repute on matters concerning the lepidoptera. In these two books he has assumed a lighter and more popular role; his aim has been—to quote his own words—"to bring under the notice of the general public, in readable and untechnical language, a few of the interesting phenomena which are to be observed everywhere around us by those who take the trouble to look for them, and to give such explanations of their causes as may easily be understood even by those whose scientific knowledge is small." He has certainly carried out his design most successfully and given to the world two very charming and interesting books on out-of-doors natural history. Any one, whether young or old, who takes any pleasure in the beauties of nature and any interest in the varied world of animal and vegetable life, will read them with the greatest delight and follow the author with unflagging interest during his rambles over hill and dale, and by marsh and burn and fen. In the former work more attention is paid to the habits and variations of insects, while the latter treats of any animal or plant that may be met with in expeditions to widely different localities. Amusing episodes and pretty bits of verse enliven the volumes, and many capital pictures render the later one still more attractive.

C. J. S. B.

REPORT OF THE ENTOMOLOGICAL DEPARTMENT OF THE NEW JERSEY AGRICULTURAL COLLEGE EXPERIMENT STATION: By John B. Smith, Sc.D., for the year 1893.

It is obviously impossible to notice all the ever-welcome bulletins and reports that constantly flow from the various experimental stations throughout North America, for copies of which we are very grateful to their authors. We may, however, call attention to Dr. Smith's excellent departure from the ordinary report. After giving the usual general review of the season, and an account of the most important insect attacks of the year, he devotes a large portion of his work to a most useful and admirable account of the "Beneficial Insects" in all the different orders. It is clearly and plainly written, so as to be within the comprehension of non-entomologists, and is profusely illustrated with excellent figures, many of them being new reproductions by means of photography. It ought to be widely distributed, in order to teach the general public that a very large proportion of insects are not noxious, and should not be wantonly destroyed. C. J. S. B.

REPORT OF THE ENTOMOLOGIST AND BOTANIST (JAMES FLETCHER, F.R.S.C., F.L.S.), Central Experimental Farm, Ottawa, 1894.

Mr. Fletcher's Reports are always interesting and valuable; and the present record of the chief insect attacks of last year, and his observations upon them, is not less so than its predecessors. The season of 1893, as far as destructive insects were concerned, was only remarkable for the superabundance of locusts (grasshoppers), and the consequent damage inflicted upon oats and many other field and garden crops. Other attacks were for the most part of the familiar kinds which we have always with us; these are briefly mentioned in the Report, while more attention is paid to the serious injury caused to grain crops in Manitoba and the North West by cut-worms, the ravages of locusts, granary insects at the Chicago Exhibition, the horn-fly, etc. Very interesting accounts are also given of *Silpha bituberosa*, which attacks vegetables in the North West Territories; and *Polyphylla decemlineata*, which was very injurious to shrubs of various kinds in a nursery at Victoria, B.C.

In the Botanical section of the Report there are two papers especially noteworthy: those, namely, on "Grass for the protection of shores and harbors," and on the "Tumble-weeds" of the North West. The pamphlet is illustrated by a handsome full page picture of Mr. Fletcher's grass plots at the Experimental Farm, which are full of interest to every visitor; and thirty wood-cuts. It is gratifying to observe how steadily the author's reputation is growing, and how highly his work has come to be appreciated from one end of the Dominion to the other.

C. J. S. B.

EIGHTH REPORT OF THE INJURIOUS AND OTHER INSECTS OF THE STATE OF NEW YORK FOR THE YEAR 1891 : By J. A. Lintner, Ph. D, State Entomologist, Albany, 1893.

Anything published by Dr. Lintner is sure to contain much valuable information and to be highly interesting, whether the subjects treated of are new to us or not. The Report before us fully supports this statement. It treats of a large number of insects, injurious or otherwise; and gives in most cases a life history of each, including the author's own observations, which are always accurate and clearly detailed. Attention may especially be drawn to the accounts of the Raspberry Geometer (*Synchlora glaucaria*), the Birch-leaf Bucculatrix (*B. Canadensisella*), and the Pear-midge (*Diplosis pyrivora*). An appendix contains some very interesting popular lectures on Economic Entomology, which are well worth perusal. The only drawback to the Report is the late date of its publication, which is more than two years after the observations recorded in it were made. C. J. S. B.

BUTTERFLIES FROM CHINA, JAPAN AND COREA : By John Henry Leech, B.A., F.L.S., etc. In parts, 4-to, 642 pp, 43 plates; R. H. Porter, London, Dec., 1892 —Jan., 1894.

The fifth and last part of the letter-press of Mr. Leech's work has just been issued, and is accompanied by the statement that five plates of Hesperidæ and a supplemental plate will shortly follow, completing the work. Presumably these plates will be accompanied by the letter-press of the title page, preface and index, with which the work will be ready for the binder. As to the typography of the book, it must be said that it leaves nothing to be desired. The paper is luxuriously heavy: the type is beautifully clear and large; and the text conspicuously free from errors of a minor character, such as occasionally appear even in the most carefully edited works. The scholarship and taste of Mr. Leech and his accomplished secretary, Mr. Richard South, are reflected in the execution of the literary portions of the work. The plates, which are from drawings by William Purkiss, and are executed by chromo-lithography by William Greve, of Berlin, are without doubt the finest examples of this form of work which have as yet graced any similar publication. While a preference is by many accorded to figures lithographed and afterwards colored by hand, and the most exquisitely perfect illustrations have been produced in this way; and while the results of chromo-lithography as ordinarily employed in scientific illustrations have generally been more or less marred by striking crudities, these plates before us are most marvellous illustrations of the capabilities of the chromo-lithographic process, when employed by those who are masters of the art. The plates are almost perfect facsimiles in form and color of Mr. Purkiss's exquisite drawings; and the student of Chinese and Japanese lepidoptera may well rejoice upon having at his command such an infallible guide to specific identity as is found in these beautiful illustrations. The only adverse criticism which the mechanical and typographical execution of the work admits is on the score of the bulk of the letter press, which will necessarily be bound up in one volume. The heavy paper employed results in the production of a book which, as a manual of reference, promises to be somewhat uncomfortably "fat."

The title of the book indicates the consciousness of the author that, in our present state of knowledge, any effort to deal with the lepidopterous fauna of the great regions covered by this work must at best be attended by imperfections. There are wide areas in China in which little or no attempt has yet been made to make collections: and it must necessarily be many years before it can be asserted that our knowledge of the faunistic resources of Central Asia is complete. In his classification, Mr. Leech follows the order now almost universally recognized by writers in England and on the continent as most natural. He erects, as far as the writer has been able to observe, no new genera; and while giving us a large number of new species, appears to have pursued a conservative course in this regard, which is to be commended. To the student of Asiatic lepidoptera the work is simple indispensable, and will remain a lasting monument of the energy and scientific accomplishments of its learned and enthusiastic author. W. J. HOLLAND.

MISCELLANEOUS ENTOMOLOGICAL PAPERS, BY F. M. WEBSTER, FEB 1894.

We have just received a neat pamphlet of 59 pages, which forms Bulletin 51 of the Ohio Agricultural Experiment Station. It is by Prof. F. M. Webster and like all his work shows careful preparation.

The insects treated of in the first part are: The asparagus beetle, the western corn root worm, the broad striped flea beetle, blister beetles, the basket worm, the cabbage aphis and the apple leaf louse.

An interesting account of the insects which have been introduced into the State is given under the head of "Some insect immigrants in Ohio." There appears to have been two great highways which insects imported from Europe have followed: those which have entered the State at its northeastern corner and spread westward, and those from Southern Europe which have generally entered by way of the Ohio Valley and have a more or less restricted northern distribution.

In the article "Insect foes of American Cereals" the writer is evidently dealing with a subject of which he has made a special study. By patient observation and the application of practical common sense, Prof. Webster has made some important discoveries in Economic Entomology. Not the least of these is the fact recorded in this pamphlet that the apple aphis passes part of the year as an injurious enemy on wheat. Infact Mr. Webster says: "So far as my own observations go, it is more detrimental to the wheat than to the apple." This is an important discovery and will doubtless draw the attention of entomologists to this important subject of the "Alternation of Generations" among the aphides—a line of investigation which has engaged much of the time of Messrs. Riley and Howard at Washington. Speaking of remedies, Prof. Webster says: "It would appear almost visionary to advocate spraying apple orchards with kerosene emulsion in mid-winter to protect the wheat crop, but nevertheless one of the most serious enemies of young fall wheat passes its egg stage on the twigs of the apple during the winter season. I refer to the apple leaf louse, (*Aphis mali*, Fab.")

"Soon after the young wheat plants appear in the fall the winged viviparous females of this species flock to the fields, and on these give birth to their young, which at once make their way to the roots, where they continue reproduction, sapping the life from young plants . . . . though they are seldom killed outright, these infested plants cease to grow, and later take on a sickly look, and not until the aphis abandons them in autumn to return to the apple, do they show any amount of vigor. It is very seldom that the affected plants fully recover, at least in autumn; and the result must be to reduce their productiveness the following year." The eggs of the apple leaf aphis are deposited on the twigs and limbs of apple trees late in the autumn; these do not hatch until the following spring; the plant lice remain on the apple trees for two or three generations, when winged females are produced, which fly to grasses and weeds and there pass the summer. After the young wheat is up in the autumn, the lice congregate on the plants and reproduce rapidly.

The above is briefly the life history of this insect in Ohio as worked out by Prof. Webster by careful experiments which are detailed in the Bulletin. At Ottawa this probably may also, to a large extent, be the case; but the aphis is also sometimes abundant on young apple trees right through the season. It is, however, seldom injuriously abundant in Ontario, although in British Columbia it is to-day one of the most serious enemies of the apple grower.

Prof. Webster's paper will doubtless cause many other entomologists to study this insect more closely, when it is probable that further discoveries will be made, perhaps not less interesting than that now discussed.

J. F.

THE INTER-RELATION OF INSECTS AND FLOWERS.

During the last 8 years there have appeared from the pen of Mr. Charles Robertson of Carlinville, Ill., several most interesting articles on the inter-relation of insects and flowers. The titles are as follows :

Botanical Gazette—

1886. Notes the on pollination of Asclepias.

1887. Insect relations of certain Asclepiads.

1887. Fertilization of Calopogon parviflorus.

1888. Effect of the wind on bees and flowers.

1888. Zygomorphy and its causes : I-III.

1889-93. Flowers and Insects : I-XI.

Trans. Am. Ent. Soc.—

1889. Synopsis of North American species of Oxybelus.

1891-93. Descriptions of new species of North American Bees.

Trans. St. Louis Acad. of Science—

1891-92. Flowers and Insects : Asclepiadaceæ to Scrofulariaceæ, Umbelliferæ, Labiatæ.

Mr. Robertson began in 1886 to study the visits of insects to flowers and by his persevering observations he has succeeded in collecting an enormous number of facts which he has published mostly in the *Botanical Gazette* and in the Transactions of the St. Louis Academy of Science.

He has studied the subject especially from a botanical point of view and has given particular attention to the attractions offered to insects by the flowers of different species of plants, to the peculiarities of arrangement of their different parts, to their coloration, and to the modifications which many flowers seem to have undergone from their being constantly frequented by certain species of insects.

Such studies have nevertheless an immediate bearing on entomology, as they give us at the same time an insight into the purposes of insects in visiting flowers, into their habits of feeding and collecting either nectar or pollen, or both at once, and into the intelligence they display in order to attain their end. The close attention thus necessarily given to insects, has had besides the natural result of causing Mr. Robertson to discover that many of those insects which he was observing in his locality, Carlinville, Ill., had not even been described. Therefore, he found it necessary at first to pay particular attention to collecting and determining insects. He was helped in this work by specialists in Diptera and Coleoptera, and had himself to work out and describe many species of Hymenoptera : 10 out of 14 species of *Oxybelus*, 28 out of 30 of *Andrena* and at least thirty other species of Andrenidæ. The descriptions of these have appeared in the Trans. Am. Ent. Soc., 1889-1893.

The two great agencies of cross-fertilization of flowers are the wind and insects ; hence Mr. Robertson has thus been led to notice some interesting facts concerning the effect of wind on bees and flowers.—*Bot. Gaz.*, xiii., 1888, p. 33.

The first papers by Mr. Robertson are on the pollination of Ascelepias, the flowers of which are most interesting in their peculiar adaptation for cross-fertilization by the agency of insects. Their structure and the great difficulty the smaller insects have in effecting pollinations, leads Mr. Robertson to believe, "that bumble-bees have had most influence in modifying the flowers, and they are the most common visitors after the hive bees. Hive bees, it is to be remembered, do not belong to our fauna."

Our space is too limited to allow us to follow the writer into what he has observed in all the different orders and species of flowering plants studied ; but the names of all the insects observed visiting the flowers, are given, as well as tabular data of the respective number of visitors of the different classes, Hymenoptera, Diptera, Lepidoptera,

Coleoptera and Hemiptera. As an instance, it may be mentioned that on the flowers of *Ceanothus Americana* there were seen forty-eight species of Hymenoptera, forty five of Diptera, two of Lepidoptera, thirteen of Coleoptera, and four of Hemiptera; and considerations are given as in the case of all other blossoms treated of, on the arrangement of the flowers, their form, color and other peculiarities of structure, some of them exceedingly minute, in which close and patient observation often succeeds in discovering most wonderful purpose and design for insuring cross-fertilization.

These investigations are of great interest and we commend them to the attention of entomologists and botanists as a fertile field of useful special study. Our idea of mentioning these excellent articles of Mr. Robertson's is to draw to this subject the attention it deserves from entomologists, who from their place of publication might not be aware of their existence.

J. A. GUIGNARD and J. FLETCHER.

A PEN SKETCH OF PROF. WILLIAM SAUNDERS, F.R.S.C., F.L.S., ETC.*

By F. W. GODING, M.D., Ph.D., Rutland, Illinois.

A sketch of the life of Wm. Saunders is peculiarly instructive to young men, because of the fact that he has accomplished so much with so few opportunities in the way of a liberal education, having left school at the age of fourteen; but by painstaking study and observation he has risen to the topmost pinacle of fame as an entomologist, horticulturist and experimental agriculturist. He was born in Crediton, Devonshire, England June 16, 1836. At the age of twelve with his parents he removed to Canada, and two years later was apprenticed to a chemist. After learning the art he engaged in business, continuing it in London, Ont., until his recent promotion in 1886 to the Directorship of the Dominion Experimental Farms. A sa chemist and pharmacist he is well known throughout the United States and Canada, his published papers being widely copied and translated into several foreign languages. He was President of the American Pharmaceutical Association in 1877-8, while in 1874 he was elected an honorary member of the Pharmaceutical Council of Great Britain. The Canadian Government recognizing his special qualifications appointed him Public Analyst, in which capacity he did good service in detecting and exposing adulterations, especially in articles of food. He was for a number of years, preceeding his recent promotion, Professor of Materia Medica in the Medical Department of Western University in London, Ont., a position he was peculiarly qualified to fill.

Coupled with all these attainments he has others in which we are far more deeply interested. As an entomologist and horticulturist he is known to every student of either branch, and to mention all the things accomplished by him in these departments would require far more space than is allotted to this paper. He began the study of botany some thirty-five years ago, publishing the first list of plants found in Western Ontario, embracing 545 species, in 1863. Some time prior to this he captured a fine specimen of *Papilio turnus* (in 1859 or 60) and found it possessed of so many beauties that he was led to look for others. From this chance occurrence he was directed to the study of insects in general, and as an entomologist is considered second to none in point of eminence. At the time of the organization of this society, in 1863, he took an active part, and much of its present flourishing condition is due to his careful management as President, a position he occupied during the greater part of its existence. While editor of the *Canadian Entomologist*, the only entomological magazine ever published in America that has been able to live to attain its majority, he was also one of its principal contributors, his articles published therein and in your society reports reaching many hundreds. The

*This account of the life of Prof. Saunders, whose portrait is prefixed to this Report, was written two or three years ago, and will be read with interest as conveying the impressions of a foreigner, who cannot be charged with the partiality of intimate friendship.—ED.

crowning work of his pen, however, is his "Fruit Insects," a magnificent volume of 436 pages, which has reached the second edition. The book has been received all over the world as the most valuable work of the kind ever published. One reviewer says of the book:

"We do not think that we are speaking too highly in praise of the work—though we admit it is saying a great deal—when we express our opinion that Mr. Saunders's volume will take rank with that standard of excellence, Harris's injurious insects of Mass., and that he has done for insects affecting fruits at the present day what his justly famed predecessor accomplished long ago for those injurious to vegetation in general."

It appears that the work was just what was wanted from the immense sale of it, about 2,500 copies having been sold. This seems all the more strange when it is stated that the average circulation of entomological works rarely exceeds two or three hundred copies.

Since 1867 he has been a director of the Fruit Growers' Association of Ontario, and its president since 1882. In his experimental grounds he has tested a great variety of fruits, laboring constantly to ascertain which are best adapted to the climate of Canada. In this manner he has, by experiments in cross-fertilization, obtained several good raspberries, gooseberries and grapes. His interest in horticulture and forestry has prompted him to become familiar with these important departments and caused him to awake general interest in these matters in the province in which he lives.

A special commission was appointed by the Government of Ontario, in 1880, to inquire into the progress and condition of agriculture in the Province. As one of the commissioners, Mr. Saunders was charged with the special duty of inquiring into the subjects of fruit growing and forestry, insects and insectivorous birds, and bee keeping. In his report, published in a large 8vo volume of over 850 pages, he treats each of these subjects as one familiar with them, leaving no topic to be hereafter completed.

As a result of this careful inquiry into the agricultural condition of the Province, the Government caused to be purchased large tracts of land located in the various Provinces, to be known as the Experimental Farms, which were fitted up with all modern appliances and buildings, properly stocked, and then placed Prof. Saunders in charge as Director. Probably nowhere in the Dominion could be found a man so well qualified, by education, tastes and executive ability, as he, to be placed in this responsible position. Already this institution has taken a front rank among similar ones and under Prof. Saunders's charge is destined to become second to none.

Prof. Saunders's services have been recognized in various ways. Some years ago he received from the Duke of Mantua and Montserrat a handsome gold medal in acknowledgment of valuable services in the interests of natural science. He is Fellow of A.A. A.S.; of Linnean Society of London, and of Royal Microscopical Society of London, England; one of the twenty original members of the Royal Society of Canada; Corresponding Member of American Entomological Society; Natural History Society of Montreal; Buffalo Society of Natural Science, etc., etc.

He was married August 1st, 1857, to Sarah Agnes, daughter of Rev. J. H. Robinson, of London, Ontario. They have six children, one daughter and five sons. Several of the latter have inherited the tastes of their honored sire, and are working their way into public favor.

Prof. Saunders is five feet ten inches in height, with a symmetrical figure, and weighs about 175 pounds. His hair is dark brown, his eyes blue. He is one of the most approachable of men, with a look of kindness ever beaming from his genial countenance, yet with a quiet dignity which forbids familiarity.

And now our pleasant task is done. Prof. Saunders at last has found a sphere in which his broadly developed abilities have ample space in which to labor. And here we leave him with the agricultural eyes of Canada ever upon him, awaiting developments that are sure to come and wholly for their interests.

OBITUARY.

THE LATE DR. HAGEN.

Hermann August Hagen was born May 30, 1817, at Konigsberg, in Prussia. His parents were Carl Heinrich Hagen, Professor of Political Economy, Technology and Agriculture at the University of Konigsberg, and Anna Dorothea Linch. His first instruction was received at the gymnasium ' Collegium Friedericianum," whence he was transferred in 1830 to the " Kneiphofische Gymnasium." He graduated in 1836, studied medicine at the University of Konigsberg and received the degree of Doctor of Medicine in 1840. After the death of his grandfather, Carl Gottfried Hagen, Professor of Natural History in Konigsberg, the latter's entomological collection and library came into the possession of the grandson. Under his father's direction he studied entomology in his leisure time, collecting chiefly Odonata, because by chance the first specimen he caught proved to be an undescribed insect of that order. While he became gradually more interested in this particular study, he had the benefit of some instruction from two eminent and still active naturalists, Theodor von Siebold and Carl Ernst von Baer, who called his attention to the necessity of the study of medicine for the naturalist, the knowledge of pathology being indispensable to a comprehension of any normally constituted organism. He attended also for several years the lectures of Professor Rathke, the celebrated embryologist, and accompanied him in 1839 on his scientific journey through Norway, Sweden and Denmark, studying chiefly the anatomy and habits of marine animals. In 1840, he published at Konigsberg, as a dissertation for the degree of Doctor of Medicine, a little work entitled "Synonymia Libellulinarium Europaeorum." From 1840-1 he studied at the University of Berlin and passed, according to the law of Prussia, the necessary examinations as physician and surgeon. He then travelled through the greater part of Europe. In Vienna he attended clinical and medical lectures for six months, and in Paris for nearly a year. The study of natural history was in the meantime always pursued, so far as time and circumstances allowed, and his acquaintance with Baron de Selys-Longchamps, of Liege, made in Paris, 1842, gave rise to a series of entomological publications containing their combined studies of the family of the Odonata. He was favored at this time with the counsel and encouragement of the prominent entomologists, Klug, Erichson, Kollar, Von Siebold, and many others whose personal acquaintance he had made during his travels. He returned to Konigsberg in 1843, and settled there as a practising physician. For three years he was first assistant at the surgical hospital, performing the greater part of the operations. In 1851 he was married to Johanna Maria Elise Gerhards. His duties as a physician limiting his studies in natural history to leisure hours, he confined himself to entomology (with especial reference to the Neuroptera), entomological biology, and the study of the microscope. The fear of wasting time in investigating subjects which had already been elucidated induced him to catalogue carefully all accessible entomological publications. This compilation, begun for his own use, was afterwards published as "Bibliotheca Entomologica," in two volumes, Leipzig, 1862. Alone, or jointly with Baron de Selys-Longchamps, he has published in various scientific periodicals a large number of notes, papers and monographs, all of which, up to 1861, are mentioned in his " Bibliotheca." His first publication was made in 1834, on " Prussian Odonata." It was his wish to prepare monographs in all families belonging to the Linnaean Neuroptera, but circumstances did not permit the full execution of this plan. In 1849, 1857 and 1861 he made extended scientific journeys through Germany, Belgium, Holland and England for the sake of comparing collections and libraries. From 1863 67, his official duties as Vice-President of the City Council and Member of the School Board of the City of Konigsberg left him no leisure. A large number of reports on a great variety of subjects relating to these duties demanded much careful study. Some of them, as for instance one on " Life Insurance," are exceedingly elaborate treatises. In 1863 he received the honorary degree of Doctor of Philosophy from the University of Konigsberg.

He was corresponding or honorary member of a large number of learned societies. In 1867 Professor Agassiz invited him to come to Cambridge as assistant in entomology, and in 1870 he was appointed Professor of Entomology in Harvard University.*

"Dr. Hagen entered upon his duties at the Museum with great zeal; and his detailed plan for the arrangement of the collections, though somewhat modified, is, and is likely to remain, the basis for the future. Deeply interested in everything relating to museum work, as his appreciation of series of specimens, his care for their preservation and for the accuracy of their localities, and many minor details, clearly indicate, it is in this collection as well as in his writings that his contributions to science are to be found. Here alone we can fully realize the extent of his discoveries, the keenness of his insight, his skill at preparation and dissection, and with the pencil. His devotion to the Museum knew no bounds; all personal interests were secondary. In 1876 he refused a most flattering and urgent invitation to take charge of the great entomological collections of the Konigliches Museum fur Naturkunde in Berlin, and the time that might have been given to original work was lavished upon the care and arrangement of the collections, which grew rapidly both in size and value. The biological collection, or that illustrating the life history of the species, is a prominent specialty of the Cambridge Museum. In this are preserved specimens showing every condition of an insect's life, the eggs, larvæ in all stages, from those just hatched to those full-grown, their burrows, nests, partially devoured leaves, etc., the work of both larvæ and adults, the frass or excrements often of great importance, pupal stages, adults of both sexes, and the parasitic and predaceous enemies, also in all stages of development. Dr. Hagen's influence upon the formation of such biological collections has been very great; few were in existence at the time when, almost unaided, he created that at Cambridge, and the care and elaborateness with which the whole is labelled makes it not only a worthy model, but most truly a monument to persistent and well-directed industry.

"His lectures, given at rare intervals to advanced students, contained much genuine and exact knowledge, and his many acts of kindness and words of wise counsel will not soon be forgotten by those who enjoyed the facilities of the Department under his charge.

"Most of Dr. Hagen's journeys were undertaken for study among collections and in libraries. In the summer of 1882, however, accepting the generous and thoughtful invitation of Professor Raphael Pumpelly, at that time Director of the Northern Transcontinental Survey, he visited California, Oregon, Washington and Montana. The object of the survey was to collect data concerning insects injurious to vegetation, both of the field and of the forest. The greater part of the time was spent in the Yokima and Columbia regions of Washington; many important entomological discoveries were made, some with a direct economic bearing, and large collections of insects were obtained from a most interesting locality.

"Dr. Hagen was a man of marked character, simple and sympathetic, and if at times somewhat hot and hasty in temper and impatient of opposition, he had also one of the warmest of hearts and most generous of dispositions. His unostentatious hospitality was enjoyed by many entomologists, who found his life in Cambridge quiet, contented and happy.

"Of Dr. Hagen's domestic life it is sufficient to record here that in 1851 he married Johanna Maria Elise Gerhards, who survives him.

"Dr. Hagen received the honorary degree of Doctor of Philosophy from the University of Konigsberg in 1863. Harvard made him a Doctor of Science in 1887. The renewal of his medical degree on the 17th of October, 1890, the date of his graduation fifty years previously, after the custom of German Universities, gave him great pleasure. He was elected a fellow of the American Academy of Arts and Sciences, November 11, 1868, and served on the Council in 1877-78. He was also a member of a goodly number of scientific associations and most of the entomological societies the world over were glad to enroll him as an honorary member.

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* [illegible] "The Museum of Comparative Zoology," in The Harvard Book, by F. O. Vaille and H. A. Clark. Cambridge, 1875, Vol. I., p. 345-346, with portrait.

"Stricken with paralysis in September, 1890, Dr. Hagen lingered for more than three years; his painful sufferings being lightened by all that affectionate and devoted care could do. He died at Cambridge, Mass., November 9, 1893, and was buried in the grounds of Harvard University, at Mount Auburn, near his associate, Louis Francois de Pourtalès." (Samuel Henshaw, in the *Proceedings* of the American Academy of Arts and Sciences, Vol. xxix., 1894.)

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TWENTY-SIXTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF

ONTARIO

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PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE, TORONTO.

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY.

183583

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WILLIAM H. EDWARDS,
Honorary Member of the Entomological Society of Ontario, etc.

TWENTY-SIXTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY OF ONTARIO,

1895.

To the Honorable the Minister of Agriculture :

SIR,—In accordance with the provisions of our Act of Incorporation, I beg to submit herewith the Twenty-Sixth Annual Report of the Entomological Society of Ontario.

The report contains an account of the proceedings at our annual meeting, which was held in the city of London on the 27th and 28th of November last, for the election of officers and the transaction of the general business of the Society. A full report is given of the addresses delivered and papers read during the sessions, as well as the financial statement of the Treasurer and the reports of the sections and other departments of the Society.

The Canadian Entomologist, the monthly magazine issued by the Society, has been regularly published and has now completed its twenty-seventh volume, which in value and interest fully maintains the high reputation which it has so long held.

I have the honor to be, Sir,

Your obedient servant,

W. E. SAUNDERS,

Secretary.

OFFICERS FOR 1896.

President	J. W. DEARNESS	London.
Vice-President	H. H. LYMAN	Montreal.
Secretary	W. E. SAUNDERS	do
Treasurer	J. A. BALKWILL	do
Directors :		
Division No. 1	JAMES FLETCHER	Ottawa.
" 2	REV. C. J. S. BETHUNE	Port Hope.
" 3	GAMBLE GEDDES	Toronto.
" 4	A. H. KILMAN	Ridgeway.
" 5	R. W. RENNIE	London.
Librarian and Curator	J. A. MOFFAT	do
Auditors	J. H. BOWMAN	do
	J. M. DENTON	do
Editor of the "Canadian Entomologist"	REV. C. J. S. BETHUNE	Port Hope.
Editing Committee	J. FLETCHER	Ottawa.
	H. H. LYMAN	Montreal.
	REV. T. W. FYLES	S. Quebec.
	J. M. DENTON	London.
Delegate to the Royal Society	J. D. EVANS	Trenton.
Committee on Field Days	DR. WOOLVERTON, MESSRS. SHERWOOD, McCLEMENT, BALKWILL, SAUNDERS, ANDERSON, RENNIE, BOWMAN, ELLIOTT, AND STEVENSON	London.

ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY

1895

The thirty-third annual meeting of the Entomological Society of Ontario was held in its rooms in Victoria Hall, London, on Wednesday and Thursday, November 27th and 28th, 1895. In the absence of the President, the chair was taken by the Vice-President, Mr. J. W. Dearness, of London.

The meeting was called to order at four o'clock p.m., on Wednesday, the following members being present: Rev. C. J. S. Bethune, Port Hope; Mr. J. D. Evans, Trenton; Mr. James Fletcher, Ottawa; Mr. H. H. Lyman, Montreal; Rev. T. W. Fyles, South Quebec; Messrs. J. A. Balkwill, J. M. Denton, E. R. Cameron, J. A. Moffat, W. E. Saunders, R. W. Rennie, W. T. McClement and others, of London. A letter of apology was read from Mr. W. H. Harrington, of Ottawa, President of the Society, and a telegram from Capt. Gamble Geddes, of Toronto, regretting their inability to attend the meeting.

Mr. J. A. Moffat, the Librarian and Curator, presented and read his annual report, as follows:

REPORT OF THE LIBRARIAN AND CURATOR

FOR THE YEAR ENDING 31ST OF AUGUST, 1895.

The number of volumes added to the library by gift and purchase during the year was twenty-two. Ten volumes were sent to the binder, but some delay occurred in their return, which prevented their being entered within the year. I considered it desirable to include them in this statement, and in doing so, I had to include several others previously entered, which bring the number added to date up to thirty-eight.

The whole number on the register is 1,399.

The number of volumes issued to local members was thirty-three.

Mr. Fletcher has generously contributed to the library six volumes of the proceedings of the American Association for the Advancement of Science.

Many interesting additions have been made to the Society's collection of native lepidoptera during the year; principally by Mr. C. G. Anderson, one of our local members.

The specimens of *Nemeophila petrosa* received from Mr. Bean of Laggan, have been given a drawer to themselves, arranged in order as upon the plate, with the original numbers attached. The portions of Mr. Bean's paper descriptive of the individual specimens have been placed with them.

Mr. Rennie obtained by exchange cocoons of *Platysamia ceonothi*, and *Antheræa mylitta*, "the India Tussah silk moth," which he kindly shared with the Society. These matured and gave forth their imagoes, which have been placed with the exotic collection.

Respectfully submitted,

J. ALSTON MOFFAT,
Librarian and Curator.

The Treasurer, Mr. J. A. Balkwill, presented the annual statement of the finances of the Society, as follows:

REPORT OF THE TREASURER.

RECEIPTS.	
Balance on hand Sept. 1st, 1894	$ 360 60
Members' fees	309 39
Sales of Entomologist	88 56
" pins, cork, etc	66 61
Government grant	1,000 00
Advertisements	21 40
Interest	9 47
	$1,856 03

EXPENDITURE.	
Printing	$ 644 33
Report and meeting expenses	216 00
Library	47 38
Expense, postage, etc	117 02
Rent and fuel	102 70
Insurance	28 00
Salaries	300 00
Pins, cork, etc	58 69
Balance on hand, August 31st, 1895	341 91
	$1,856 03

We hereby certify that we have examined the books of the Treasurer and compared them with the vouchers, and find them correct and that the above is a correct statement.

John M. Denton,
Jas. H. Bowman, } Auditors.

The Treasurer explained the various items of receipts and expenditure and stated that it would require the closest economy to carry on the work of the Society during the remainder of the year. Dr. Bethune and Mr. Fletcher spoke in commendation of the valuable services of Mr. Balkwill and of the high appreciation in which they were held by the members of the Society.

Mr. W. E. Saunders gave an account of the proceedings of the local members of the council with regard to obtaining more suitable and commodious rooms for the Society. After a long discussion, which was participated in by most of the members present, it was resolved that the matter be left in the hands of the local members of the council, who were authorized to take whatever action seemed to them most desirable for the welfare of the Society.

An application from the Senate of the Western University of Ontario was read requesting that their students in geology should be permitted to attend, free of charge, the meetings of the geological section of the Society. After some consideration it was resolved that the matter should be left in the hands of Dr. Woolverton, who is to deliver the lectures, and that he should have the liberty, which is shared by all the members, of introducing friends to the meetings of the section.

The following report of the council was next read and adopted:

REPORT OF THE COUNCIL.

The council of the Entomological Society of Ontario have much pleasure in presenting the following report of their proceedings during the past year:

They have much satisfaction in stating that the membership of the Society in London, and in the Province of Ontario generally, has largely increased, and that additions have also been made to our numbers in other parts of the Dominion, especially in British Columbia. The list of subscribers in the United States and Europe has continued about the same. The total number of names on our books is now considerably larger than ever before since the formation of the Society, while the interest in its work has by no means diminished.

The twenty-fifth annual report on Economic and general Entomology was presented to the Minister of Agriculture for Ontario in November last, and was printed and distributed at the beginning of January. It contained one hundred and twenty-six pages, a larger number than hitherto, and was illustrated with no less than sixty wood cuts, and two full page portraits, one of Prof. William Saunders, one of the founders and for many years President of the Society and editor of *The Canadian Entomologist*, and the other of Mr. A. R. Grote, of Hildesheim, Germany, one of our honorary members and a constant contributor to our publications. In addition to an account of the proceedings at the annual meeting, the volume contains the annual address of Mr. Harrington, the President, and the following interesting and important papers: "Insects collected in Bermuda," by Capt. Geddes; "Common names for Butterflies—Shall we have them?" by Mr. Lyman; "The Butterflies of the Eastern Provinces of Canada," by Dr. Bethune; "The Pitcher-plant Moth," The Gypsy Moth," "The San Jose Scale," and "Injurious Insects of the year 1894," by Mr. Fletcher; "Foods, Feeders and Fed," by Mr. Fyles; "The economic value of Parasitism," by Mr. F. M. Webster; "The structure of the undeveloped wings of the Saturniadæ" and "A reappearance of Pieris protodice," by Mr. Moffat; also a report of the sixth annual meeting of the Association of Economic Entomologists together with a few of the most interesting papers.

The Canadian Entomologist, the monthly magazine published by the Society, completed its twenty-sixth volume in December last. The numbers of the twenty-seventh volume have been regularly issued at the beginning of each month during the current year; the closing number for December is now in type and will be distributed next week. The volume when completed will consist of about 360 pages, and is illustrated by no less than six full page plates and twenty-three wood cuts. Among the contributors to its pages are most of the leading Entomologists in North America as well as several in Europe. It is now the oldest monthly publication on insects published in America, and continues to maintain the high reputation that it has so long enjoyed.

A noteworthy event in the history of the Society is the republication, through the kindness of the Minister of Agriculture for Ontario, of the first annual report of our Society, which was prepared by Messrs. Bethune, Saunders and Reed in the year 1870, and published early in 1871. It contains articles on the insects injurious to the apple, grape and plum, and has been for some time out of print. Nothwithstanding that almost a quarter of a century has gone by since it was first issued, the volume is still in demand for public libraries and private collections.

The cabinets of the Society have been carefully looked after by the Curator, Mr. J. Alston Moffat, during the past year, and many valuable additions have been made. The collections owe many of these additions to the zealous work of Mr. C. G. Anderson, who has devoted much time and energy to the lepidoptera in the neighborhood of London. Mr. Bean, of Laggan, has presented a set of the specimens of *Nemeophila petrosa* which were illustrated in the April number of *The Canadian Entomologist*. Mr. Rennie has presented specimens of some interesting silk moths, of which he had obtained the cocoons; and Mr. Rowland Hill a beautiful case of Australian insects.

Mr. E. Firmstone Heath, of Cartwright, Manitoba, has sent through Mr. Fletcher, some interesting and rare lepidoptera captured in his own neighborhood; and Mr. Green, of Osoyoos, British Columbia, has also sent some very valuable and typical representative specimens of butterflies from the Okanagan valley.

The library is steadily growing and now numbers 1,400 volumes, many of them being rare and extremely valuable works.

The report of the Treasurer shows that our finances are in a satisfactory condition. The balance on hand at the close of the financial year is about the same as in his statement at our last annual meeting, and will all be absorbed by the expenses attending the remaining portion of the year. The question of rooms for the Society will have to be dealt with very soon, as the present quarters are too small for the library and collections and the meetings of the sections. It is to be hoped that the new council will be able to settle the matter to the general satisfaction.

The reports of the geological, microscopical and botanical sections are presented herewith. They have held regular meetings during the past season and have accomplished much satisfactory work. The ornithological section has become so much reduced in numbers that no meetings have been held, but it is confidently expected that there will be a revival of interest next year.

The Society was represented by the Rev. T. W. Fyles at the annual meeting of the Royal Society of Canada held in Ottawa in May last. His report is also presented herewith.

All of which is respectfully submitted,

W. E. Saunders,
Secretary.

Mr. Lyman read the report of the Montreal branch as follows :

REPORT OF THE MONTREAL BRANCH.

Annual meeting of the Montreal branch of the Entomological Society of Ontario.

The twenty-second annual meeting of the Montreal branch was held in the library of the Natural History Society, on Tuesday evening, 14th May, at 8.15 o'clock.

Members present : Messrs. H. H. Lyman, President ; Lachlan Gibb, Vice-President ; Geo. Kearley, and A. F. Winn, Acting Secretary.

The President presented the following report of the Council :

Report of Council.

In presenting their twenty-second annual report the council have much pleasure in congratulating the branch upon having unquestionably come of age,* and feel that so long a period of continued and unbroken existence is worthy of remark in view of the very small numbers interested in this pursuit.

During the year seven meetings were held and the following papers and communications were read :

An hour at Hochelaga, A. F. Winn.

Notes on the season of 1894, H. H. Lyman.

Note on the occurrence of Pamphila Manitoba at St. Hubert P. Q , A. F. Winn.

Mantis and Mantispa, H. H. Lymann.

How the forest of the district of Bedford was swept away, Rev. T. W. Fyles.

Note on the occurrence of of *Chionobas Tarpeia* in North America, H. H. Lyman.

Four new memb rs have been added to the branch's roll and it is to be hoped that increased energy will be shown in the study of the many inviting subjects which this department of science holds out to those students who are really in earnest in the pursuit of knowledge.

The Treasurer's report shows that the finances of the branch are in a healthy condition.

Respectfully submitted on behalf of the council.

H. H. Lyman,
President.

*It was organized 16th October, 1873.

It was moved and carried that the reports of the council and Secretary-Treasurer be received and adopted.

The following officers were elected for the ensuing year :

President—H. H. Lyman.

Vice-President—A. F. Winn.

Secretary-Treasurer—Lachlan Gibb.

Council—G. Kearley, W. C. Adams.

The meeting then adjourned.

Lachlan Gibb,
Secretary.

Regret was expressed that no member had been able to represent the Society at the annnal meeting of the Association of Economic Entomologists held at Springfield, Mass., in August last. Through the kindness of Mr. L. O. Howard a full account of the proceedings has been received, and an abstract will be found in subsequent pages of this report.

Mr. Lyman exhibited a handsome quarto volume containing beautifully colored plates of the butterflies of Germany, which only cost, when delivered here, $4.59. It is entitled "Die Schmetterlinge Mittel-Europas," by Mar Korb, and is published at Nuremburg, Germany.

A paper was next read by Mr. Lyman on *Colias Interior*, the consideration of which was deferred to the following day.

The hour of 6 o'clock having arrived the meeting adjourned.

EVENING SESSION.

In the evening the Society held a public meeting in the City Hall,which was attended by between fifty and sixty persons, for the most part members of the Society. The chair was taken at 8 o'clock by his Worship, Mayor Little; on the platform were Professor C. C. James, Deputy Minister of Agriculture for Ontario, Rev. Dr. Bethune, Rev. T. W. Fyles, Mr. Dearness, Mr. W. E. Saunders and Dr. Roome, M.P. The Mayor opened the proceedings with the following remarks :

Ladies and Gentlemen,—Our city has had the good fortune in recent years to be many times selected as the meeting place of conventions of fraternal and other societies and we are always glad to welcome them in our midst. To-night we have amongst us the representatives of a society, which, though provincial or Dominion in its character, has its headquarters in our own city and is therefore all the more welcome on that account. I am sure, although there are not a very large number present to-night, you will make up by your enthusiasm for whatever you may want in numbers. This Society has been quietly doing a very valuable work in our country. I understand that the journal which they publish is considered the most valuable work on entomology that is published on the continent of America and it is also the oldest. It is all the more interesting to us,because the Society was founded largely through the efforts of Mr. Bethune, who is on the platform to-night, and one of our own fellow citizens, Prof. Saunders, whom though at Ottawa, we still look upon as a citizen and we are proud of him and his work.. I therefore say this Society has a warm place in our hearts, because of its origin, and because it has remained among us. I am sure those who have come out to-night will not regret it.

Without any further remark I will call upon Prof. James of the Department of Agriculture, Toronto, to address the meeting. (Applause)

THE NEW AGRICULTURE.

By Mr. C. C. James, Deputy Minister of Agriculture.

Mr. Chairman, Ladies and Gentlemen, and members of the Entomological Society, I believe it is somewhat of an innovation for the Ontario Entomological Society to hold an open meeting, or as we sometimes say a popular meeting, in connection with its deliberations. This, I take it, will have the effect of bringing the Society more into sympathy with the people, or rather of bringing the people more into sympathy with the workings of the Society. As a rule we find that the best men do their work most quietly. The men in this world who do the most advertising of themselves, who create the greatest stir for the time being, are not always the most important men in the world. So with regard to many of these societies, those who are doing their work the most quietly are very frequently the ones that are doing the most important work for the community. And the very fact that this Society for twenty-five years has been carrying on its work by

itself, quietly, without creating very much stir, is not a condemnation of the Society, but, to my mind, the very fact that it is able to live after years of this quiet life shows it has that true vitality which will enable it to exist and to do good work in this world. (Applause)

We are not very many who are gathered here to-night, and what we have to say will be more in the line of a quiet talk between ourselves, more or less of a conversation one with another, with regard to the work in which we are interested. I propose to talk in regard to general agriculture and in connection with my remarks I may have something to say in regard to entomology and its relationship to agriculture. I do not consider that there is any more important question to be discussed or studied by city people, as most of you no doubt are, than this subject of agriculture. Some one may say that agriculture ought to be reserved for farmers and farmers' sons and families, and that the bringing in of the subject of agriculture at a town or city meeting is a great mistake. But there are two or three reasons that we can offer in connection with this, that are quite sufficient to warrant us in introducing a subject of this kind. In the first place we all admit that this country is first and foremost an agricultural country, that the progress of this country depends more upon agriculture than upon any other industry and that just as agriculture rises or falls so will the general prosperity of this country rise or fall with it. When the farmer is prosperous, has good crops and good prices, the people in the towns and cities feel the effect; and depression in the country is felt very soon in the city. Then again there is an old idea, now being rapidly removed, that agriculture after all is not a very interesting subject. The principal reason of talking to.night is to endeavor to show to you, in an indirect manner it may be, that after all there is a great deal of interest in agriculture for the people of our towns and cities.

There has been more or less talk of teaching agriculture in the schools and some have said it should be taught in the rural schools, but there are many people in this country who have looked into this question and who after thinking over it carefully have come to the conclusion, that agriculture should be taught in our city schools as well as in the country; that there is as much need for the education of our city pupils as for the rural in the subject of agriculture. Perhaps I may be able to show you, in a few cases at least, that agriculture is not that dry hum-drum business that many of us have sometimes thought it to be, but that connected with it are some of the most important and interesting questions that have presented themselves to the mass of human beings. We have heard a great deal of late in regard to many of the new questions, the *new woman* for instance has filled column after column of our city papers. Now it struck me in looking around for a subject that possibly I could not take anything better than this "*the new agriculture.*" (Applause.)

What are the changes that have taken place, or what are the forces that are present that have given us and are giving a new agriculture?

The first is the great increase of transportation facilities. Those of you who are older than the speaker here to-night will remember the time when transportation between the old countries of the world and this country was very slow. To-day we have the great continents connected by lines of steamers that run as rapidly as some of the accommodation trains upon our railroads. Nearly every continent in the world is belted by one or more great trans-continental railways. Even Russia is about completing a great trans-Siberian railway, Africa will be the next country to have a trans-continental railway. The result is that the world, so to speak, has been shrunken up and although we have these continents at distances of five to eight thousand miles apart and although we have great stretches of country such as this North America of ours, still with the improved steamship lines and railways, these countries have been so closely brought together that practically this world is now simply one great continent or one great country. What has been the effect of that? The effect has been that the great consuming markets have been brought closer to their sources of supply and it is not very much of an advantage now to be stationed a thousand, or two, or three, or four thousand miles nearer to the great consuming centres of the world, than some other countries. For instance Canada, because she is only some four thousand miles from England has not a very great advantage over Australia which

is, I think, some twelve thousand miles away. South America is practically as close to Europe to-day as we are. Africa, both in the north and south is about as close to Europe as we are. There is very little difference in the cost of transportation over these great ocean distances and the result of it has been, that these countries with great territories of fertile lands, and with cheap labor, have been able to produce with almost equal facilities the enormous quantities of crude materials, such as wheat and oats and barley, and as a consequence the great consuming countries of the world are supplied as they have never been before. And the prices of these products have been going down lower and lower until we find that one great result has been that these crude products of the farm have been brought to the great commercial centres at very low rates Let me give you a couple of instances. It costs about thirty-four cents to pay all charges for sending a bushel of wheat from Manitoba to Liverpool, let us say half a cent on a pound. From Australia butter has been shipped to London at a rate less than two cents a pound. The transportation charges have been brought so low that it is possible to ship butter in refrigerator steamships from the dock in Australia to the dock at London for a smaller amount than it can be sent by rail from the north of England to the south. So that you see the great increase in transportation facilities has reduced distances; has brought the great producing nations of the world closer to one another, and they can now barter in the markets at about equal advantage one with the other. The result of this has been that the products that are of easy production have suffered in price as a consequence, and only those products which are more difficult to produce, which are produced by the more highly cultivated people, by a people with better facilities, with better training and better education, have been able to hold their own. Our farmers to-day are turning their attention more and more to the production of these higher classed articles, these articles which require more skill, because thereby they come less and less into competition with cheap labor and cheap soil. The production of these lower grades brings their higher priced labor in competition with lower priced, whereas the production of the higher classes, such as the best class of fruit and dairying production brings them into competition, not with cheap labor and cheap lands, but with the better class of labor and lands of Europe.

The second cause is the application of machinery. This perhaps might not at first sight present itself quite as forcibly to your minds as it will if I give an instance or two. The grains as we grow them, such as wheat and barley, have been raised from time immemorial. It is impossible to say when wheat and barley and grains of all kinds were first produced upon the earth. Go back as far as you will, you will find in history and in archæological remains the traces of the instruments for cutting have been shaped something like the curved arm, the sickle, and yet if you think, it was only the other day the sickle went out of use among civilized people. From the time that wheat and barley and oats were first produced until within a few years ago, the sickle, with practically little or no change, remained the sole reaping instrument of the human race. About 1826 a Scotch minister presented for examination to the Highland and Agricultural Society of Scotland a new machine, the forerunner of what we now know as the reaping machine. About the year 1831 Cyrus MacCormack brought out the first reaping machine in the United States. It was not until the year '41 or '42 after ten long years of experiment and changing and testing that this machine was finally put upon the market. It is only within the last fifty years that the sickle, the scythe and the cradle after being used for so many centuries have been superseded by the reaping machine. All at once what wonderful developments began. The reaper and the mower, and then a very few years ago came the self-binder, and we have to-day in California the harvester and header machine, drawn by from eighteen to twenty-four horses or mules, which reaps and threshes the grain and leaves it in bags on the field. The question we ask ourselves right here is, "What next?" One hesitates to say or give an answer to that question when we see what has happened, what wonderful steps in progress have been made from the simple sickle or scythe to the self-binder. When within the period of thirty or forty years such wonderful evolution has taken place after a long period of quiescence, one may say, what will be introduced next?

Take another instance. In connection with dairying the method in olden times of churning the milk was by a very simple operation, either by means of a bag hung up and

pounded or swung around, or else in a vessel quite similar to our old-fashioned barrel churn. It is not very many years since the old-fashioned dash churn and implements of this kind were used for the manufacture both of butter and cheese. Then someone introduced the application of power, such as horse power, steam power, the introduction of the box churn and one after another applications of the various kinds of machinery began to be made, till now what have we to-day? We have a machine that can be set up in the barn to milk the cows. Although this machine is in an undeveloped condition, nevertheless it does its work and proves we are on the right track. That milk drawn by a machine can now be put into another machine and by means of it the skim-milk comes out of one spout and the cream out of another. This cream can be put into another vessel or machine, and by proper temperature and the addition of a substance somewhat resembling yeast, a fermentation can be started, and just that kind of fermentation that we desire in connection with it. After the fermentation has gone on a certain time this can be put into another machine and churned, and after churning it can be worked and packed by machinery. So that now it is possible, although not altogether practical, from the very milking to the putting of the finished article on the market, to do the whole of the work by machinery. This wonderful progress has taken place within the last quarter of a century.

As we look at farming in its different aspects, machinery has been applied at this point and that point, and agriculture is being put on an equality with the manufacturing establishments of our towns and cities. You ask yourselves this question, "Why have our great manufactures in the towns and cities developed?" The principal reason for this is in the application of machinery to the work. Why is it that machinery has been developed in connection with all these other industries and yet it has taken so long to bring the attention of inventors to the work of agriculture? Well, one reason is that there has been no great necessity for it until recent years. We sometimes hear it said that the men are leaving the farms because they are not required, because so much machinery has been brought in that a man with a machine can now do as much work as a man and two hired men could do before. There is another side to that question, viz., because of this drawing away of so many farmers' sons from the farms to the towns and cities, because of the want, therefore the supply of machinery has been produced. Both of these things no doubt have been effective. That is, machinery has been produced because it has been required; and people have left the country since they were not required because of the presence of machinery. According to the census of 1891 there were farmers and farmers' sons in Canada to the number of 649,506, in 1881 there 656,712. From '81 to '91 the number of farmers and farmers' sons in Canada decreased by over 7,000, yet during that period we had the opening up of Manitoba and also of the North-West, and the agricultural product of Canada is greater to-day than it ever was before. If you put these two or three facts together you can easily see the great part machinery has been playing in connection with agriculture in Canada for the last ten years. Although the number of farmers decreased to the extent of 7,000, nevertheless the total output of agriculture has vastly increased. This is owing to a great extent to the application of improved machinery in connection with agriculture.

The next point in connection with agriculture that I wish to refer to is one that comes as a sort of rider to the last; a companion to it, namely, the application of science to agriculture. Now, in certain quarters the moment you begin to talk about the science of agriculture and scientific farming an objection is raised and people say there is nothing scientific about it, it is all practice, and when you find a scientific farmer you find a farmer who does not make much progress.

I desire to give a few facts to show that science has been applied quite successfully to the improvement of agriculture in this country, and further, that just as we bring to bear upon agriculture the latest and best developments of the different sciences, so we may expect agriculture to make improvement. One of the great reasons why agriculture remained on a dead level for so many centuries was simply because the attention of scientific men had not been directed to agriculture as a field for investigation. Scientists had been expending their time and energy with the work that is carried on in

towns and cities. To-day we find as much attention being paid to the science of the calling of agriculture as to anything else, and the result has been wonderful progress, a wonderful development, which has begun of late and which is now in progress, and the result of which we can hardly forecast at the present time.

Let us take two or three illustrations: We sometimes hear it said that there is not very much in agriculture, that it is a dry subject, with nothing interesting in it, that it belongs so to speak to the common people and not to the literary class; there is nothing about it likely to attract the attention of people. Now, I will give you an illustration, which probably you may have had presented to you before. It has been known for years that there is wonderful difference in different crops, in the methods of their feeding. For instance, they say clover will feed in one way, that wheat will feed in another, that our common grasses of the field feed in another, and because of their different methods of feeding, therefore, it is advisable that we rotate crops, one kind one year, another kind another year. We can perhaps illustrate that by representing before us here a large table. Suppose a long table were set up in this room, filled with all manner of food, and you as an audience were asked to sit down at the table to partake or taste, and to take all you would want to eat. No two of you would want to eat the same kind of food. One man would have a preference for fruits; another man might have a great preference for meats; in fact there would be a choice in the kinds of meat. Your tastes differ; your methods of feeding differ. After you were through, if you will allow the comparison to be taken to a little lower level, suppose we were to bring in some animals of another kind whose tastes were different from ours, they would be able to take from what was left. Still there would be a portion of the food they would not take, and we could bring in something else and finally the scraps might be thrown out to the poultry. So if you alone were to be fed upon that food there would be a considerable amount that would not be taken; you could not make use of it, but what you did not want some other animal would devour; what the second class of animal would not devour the third would. Here is a large feast, so to speak, prepared by nature for plants, and we put one kind of plant upon that soil this year. It has a preference for a certain class of food and takes it, and next year another kind of plant is put upon that field which has a different fee ling capacity from the one of the preceding year and that plant takes what the other one does not want, and so on by rotating year after year, for three or four or five years, we are able to satisfy the wants of all, whereas if we kept on with the one plant year after year, we would have exhausted the particular food of that one plant and the rest of the food that was there would have been left lying idle all the time. Many farmers in years past, thinking the soils of this country were entirely inexhaustible, put in wheat this year and wheat next year and so on, until finally they were forced to the conclusion that there was nothing left for the wheat and they have taken their attention to other things. We find in many cases what was once a first-class wheat farm became a very poor wheat farm, and then after a number of years that poor wheat farm has become a first-class dairy farm, because different crops have been grown for milk, butter, and cheese.

I want to refer more particularly to one of these plants, viz.: Clover. I do not think there is any plant that presents a more interesting study, interesting though they all may be, than this much neglected and underrated clover plant. It was found that it fed in a different way entirely from the wheat, and then the question that presents itself to the minds of some of these much despised scientists is, in what way does that clover plant live? How does it differ in its feeding from other plants? After a long and careful examination, some came to the conclusion that it got most of its nourishments out of the air. Others concluded because it had a long root and it could go down into the sub-soil, that it got its nourishment there. They finally found something that had escaped the attention of most examiners, in connection with the roots of the clover plant upon which there were little knots or nodules. Now, I suppose hundreds of thousands of clover plants had been examined and these little knots had been seen. Someone who was a little more inquisitive pushed his question a little further and began to ask himself this question seriously: "Now this little bud or nodule on the roots must after all play some part in the economy of this clover plant." And to sum the whole thing this has been the

result of investigation; that these little knots are filled with very minute organisms very difficult to describe, very minute specks somewhat similiar to the very minute specks we find in yeast These are living in the roots like little parasites and the effect of their living there is to take up nitrogen from the air and in some way to give it to the plant for its subsistence, so that whenever one of these nodules comes on the clover root we find it has the means of taking up food out of the air, and then when we turn over the plant and allow it to decay in the soil, we put in the soil a certain amount of food that this plant has taken up out of the air; and the result of it is there is an excess of food there for the next plant that comes along. Now the wheat does not possess that little nodule and it does not take up the nitrogen out of the air, and the result has been that, that little investigation,—little we may call it, yet momentous in its results—has established the practice of preceding the wheat crop by a crop such as clover, or peas or beans.

Let me give you one instance in connection with entomology which has seemed to me since I read it some years ago, almost like a fairy tale. I will give it to you just as it stands. About eight or nine years ago the complete destruction of the orange groves of California was threatened by the spread of an insect known as the cottony-cushion scale. This insect was covering the limbs of the trees and the result was the vitality was being sucked right out of these trees by millions of tiny insects. The pest got completely beyond the control of the fruit growers of that country and in their despair they appealed for help to somebody or anybody. Professor Riley who was in charge of the Entomological Department at Washington, and who unfortunately met his death this year,—one of the greatest benefactors the American people has ever known—at once began the investigation of that question. Being an expert entomologist he knew practically every country in the world where that scale insect was common and he knew that the most likely place from which it had come was Australia. It had probably been introduced some twenty years before that, in bringing in fruit trees or vines from Australia. He however knew it had never become a pest in Australia. Now if it is found in Australia and later found in California and has become a pest in California and has not become a pest in Australia, he concluded that there must be something in Australia that will stop it, so he despatched two assistants to Australia to investigate it and they sent back consignments of lady-bug beetles or lady-bugs as they are commonly known. You have seen these running back and forth over the leaves and branches of the fruit trees doing great destruction to the other insects. Within a very short time, less than a year, although these scale insects had been increasing for twenty years and practically had the products of California by the throat, and in fact had taken possession of the country; in less than a year, this little lady-bug increased to such quantities that it swept the scale out of existence or got it into such control, that the fruit interests of California were saved. (Applause). I do not suppose that anybody could sit down and figure up the amount of money that was saved or made for the United States by that simple little insect brought in by a man known to very few present. You do not see his name prominent in the newspapers. The fact was not heralded broadcast in great flaming type. He was not given any great ovation. It is a question whether any monument will be erected to him by the United States, yet it is doubtful whether the United States has had any greater benefactor than that man and his associates.

Take the potato bug, what would we do to-day if we did not know that simply by dusting Paris green on potato plants we could effectually head off and kill the potato beetle. We could not raise potatoes at all. Where has that come from? It was not picked up by chance, somebody did not sit down one day and write to the paper that he thought that if you dust the potato bug with Paris green you would stop it. Back of that was careful investigation by these same men who study the habits, mode, and living and all about the potato bug. We might go on and give instance after instance. A great many of the various methods that are being practised to-day, many of the best practices we have in connection with agriculture to-day have come, not by hap hazard or by chance, but have been worked out by men on small salaries, working in obscure places, who have devoted themselves to their work with such energy as we have not had surpassed in any other calling, I care not what one you mention.

What a large portion of our reading is monopolized by a few things. I suppose the people of London know how much importance is attached to politics. It seems to be necessary the world over to have politics, but there are other things that are constantly filling the newspapers. What does that prove? That the people want to hear about these things, that the people have their attention taken up with these things, yet it is not very often that you find the most valuable columns of the newspapers given over to some great agriculture event, unless it may be in the case of agricultural depression or crop failure where there is something that is going to effect the finances of the whole country.

The point I want to make is this, there are lots of things happening in connection with agriculture, that are far more important to the prosperity of the country than these things which seem to occupy such an important place in connection with public attention. I have brought along with me a picture to illustrate that. Last summer, many of our Canadian papers were interested in a discussion, as to whether the American Society of Colonial Wars should be allowed to go down to Louisburg, Cape Breton, and erect a monument to commemorate the taking of that place by the Americans, British Colonists, as they were at that time. If I remember correctly some 150 years ago they occupied the place and held it for a short time, and then the French people took it back again. Now that event has cropped up again, after a period of 150 years. That event has been made so important to a large class of the community that they felt themselves constrained to raise a large fund, to get together a large excursion party, and to journey to Louisburg and erect that monument. It created so much attention at the time that it was a matter of doubt as to whether the Canadian Government ought to allow these people to go over there and erect the monument or not. This picture was sent me by Mr. Thompson, of Massachusetts, and I will just read you the inscription upon it. It is doubtful whether half a dozen in this room have ever seen this in the newspapers, or whether they know such a monument was erected. "This pillar, erected in 1895 by the Rumford Historical Association, incorporated April 28th, 1877, marks the estate where in 1793 Samuel Thompson, Esq., while locating the line of the Middlesex Canal discovered the first Pecker Apple Tree, later named the Baldwin." Now, I will submit it to you as to whether it was of more importance to the country to capture and hold for a short time, that little point down there on Cape Breton, or to discover the "Baldwin Apple." That Baldwin apple was discovered in 1793, and at the present day if you pick up in the fall of the year, just about this time, the market reports in Liverpool, you will find a few kinds of apples mentioned. Greenings so much a barrel, Spies so much, Baldwins so much. Practically from that day to this the Baldwin apple has been produced over the Eastern and Western States, and in Canada, and has been bringing in year by year a large amount of money to the American people. And yet events of that kind are practically lost sight of ; whereas events such as I have spoken of, are blazed forth to the country and the minds of the people are filled with it. Now it seems to me these things are out of all due proportion. Probably we cannot rectify them, yet the point I want to make here is that there are a great many things happening, there are a great many conclusions being arrived at in connection with the prosperity of this country that are entirely overlooked, whereas other events that are of little consequence after all, are magnified and fill column after column of the newspaper. What is the result of this? Suppose you ask the boys and girls in the rural parts, and the boys and girls in our towns and cities, what effect the reading of these matters has upon their minds? Is it not a fact that it suggests to their minds the paramount importance of politics and such things as concern town and city life. The result is their minds become filled with the events of town and city life ; their inclinations are drawn off in that direction ; the ties which bind them to agriculture become cut one after another, and the ties which lure them away become greater and greater, till we find a great many of these, to their discomfort afterward, are lost to agriculture and a great many men who would have made first-class agriculturalists, are drafted off in other lines of work to take second and third-rate positions.

The last point I desire to touch upon in connection with this new agriculture, is that during the last ten or twelve years, to say nothing about the past twenty-five years,

there has been wonderful development in connection with the facilities for acquiring information in regard to agriculture. These things that I have mentioned I have no doubt will be righted some day, and before long you will find the histories of this country will not be filled merely with accounts of men killing one another, they will not be filled merely with the names of persons who have occupied positions in towns and cities, but you will find there the development of the people traced. A gentleman came to me the other day who had for sale a book, dealing with the history of this country. He said: "You will find there everything in connection with this country." I said: "I will be very glad to get it, I have been looking for a great many things and have not been able to find them." Now, before you go away we will just try it. I said: "When was the first Agricultural Society formed in Ontario? "I don't know," well, I said, "that is of importance, is it not?" Is there any organization or institution that has done more to build up and develop the country, until probably within the last four or five years, than the Agricultural Society? It is of as much importance to know as when a certain kind of industry was established in some town or city. I have been on the search for it for the last five years, and finally I think I have nailed it down. There is an utter absence of all these facts in regard to the agricultural development of the country. Until we come down to the period of twenty-five or thirty years it has almost all disappeared. They can tell you of the men who have been elected to Parliament from the very first up to now. They can give you the vote that was polled in connection with any election. They can tell you, perhaps, when a certain new kind of machinery was brought into the country. They cannot tell you when the first improvement was made in connection with live stock, when the first thoroughbred live stock came into the country. I say that it is of much importance to know when these agricultural industries began and how they developed, because on these, rather than the others, the prosperity of this country has been built up. My point is, there ought to be a proper balance between these things and our histories should not be filled with other events to the exclusion of those which are equally important.

A wonderful change has taken place in the facilities for carrying on experimental work and getting an agricultural education. Take this province, we have the Agricultural College at Guelph and the Experimental Farm at Ottawa, from which our friend Mr. Fletcher comes. We have a school or college of agriculture at Kingston, and now we have a dairy school in the west at Strathroy, so we have four points in this province from which comes information in regard to some of the later developments in agriculture. Then we have six or eight different points at which experiments in connection with fruit growing will be carried on, and there is a great development along that line. Before long we will have this province dotted over with little stations from which the latest information may be obtained, and each of these will be a centre leavening the whole surrounding country.

Then we have the societies. Beginning with the time of the organization of the Province of Ontario in 1867, we have from then on had the organization of society after society, till now we have three dairy associations, two poultry associations, the fruit growers, the bee-keepers and the sheep-breeders and the swine-breeders, and a great many other stock associations, and last, but not least that association to which we are indebted to-night for this meeting, the Entomological Society which has now been carrying on its work most successfully for the last twenty-five years. I think these societies have all been accomplishing a great deal of good in this country. Some may say they do not get any great benefit, they do not come in immediate contact with the Entomological Society, but each one of these men so to speak becomes a source of information and as they go from these meetings to their homes, to this point and the other, they give out their information. They also come in contact with other men through their writings.

This Society has been quietly doing one of the most important works in connection with agriculture in this province. If these gentlemen were not present I might say something even a little more flattering with regard to them. I have had occasion from year to year of examining the reports of their meetings which they have sent out, because they are published in the department to which I am attached and I can simply say this,

that if the work of all the other societies was as well done as the work of this Society our labors at Toronto would be very much relieved. When the report comes in it is ready at once to go to the printer and we have no further work in connection with it, and year after year when I read that report I have been astonished with the amount of work that has been condensed and packed away. It is not a padded report, it is a report full of information. In looking over the list of persons to whom it is sent I find it has gone to almost every corner of the world. These men have not been content to hide their light under a bushel, but their work has gone out into every province, and has gone out into the whole world. Someone may say, "I do not see any good in finding out what is the peculiarity of certain insects or finding out just how they live." I do not see any good result coming from the work of the bacteriologist who studies with the microscope things small, so that if you were to take up a drop of milk on the point of your penknife and were able to count its inhabitants you would find 1,000,000,000 of these living plants in that drop of milk. The whole system of dairying has been revolutionized by the work of that man who is sometimes called unpractical.

Whenever I hear any of these objections I sometimes think of a saying of Franklin. Franklin you remember in connection with his experiments in electricity sent a kite into the clouds. He told the people that there was electricity up there and they laughed at him. He sent up his kite but the electricity did not come down. However, fortunate for the occasion, we are told, that the kite went up into a black, dark cloud which he positively felt was filled with electricity. Shortly afterwards the rain began to fall. It came down wetting the kite and trickling down the string. Then the hand that held the wet string began to feel the throbbing of the electricity; he proved it to them and they said. "What is the use of it?" And he said. "What is the use of a baby? It will grow to be a man." So in regard to many of these inventions or discoveries or conclusions that the entomologists, and chemists and botanists, and bacteriologists, and biologists and other scientists may find with regard to agriculture. Their discoveries are in the condition of Franklin's baby, and if we will only wait and have faith in the work we are engaged in and give true encouragement and sympathy, some of us at least may live to see these scientific babies grow up to be good, strong, stalwart men in connection with the practice of agriculture in which we are so much interested. (Applause).

At the conclusion of Prof. James's address, which was listened to with great attention and heartily applauded, Dr. Bethune rose and said:

Mr. Mayor, Ladies and Gentlemen,—I propose that we offer our very hearty thanks to Prof. James, for the able and interesting address which he has just given us. Prof. James has come, I am sure, at a grest deal of inconvenience to himself on purpose to be present with us here to-night, and to encourage us by the remarks which he has made, and also to give us a great deal of very valuable information. While thanking him for his address to-night I should also like to take the opportunity, as one of the original members of this Society, to express the gratitude that our Society must necessarily feel towards the Department of Agriculture for Ontario, of which Prof. James is Deputy Minister. He has remarked this evening that our Society has been in existence for twenty-five years and the Mayor has also mentioned to-night, that our magazine, *The Canadian Entomologist*, is now the oldest magazine touching on the subject, upon the whole continent of America. But I wish to let you know one reason why our Society and our magazine have survived so many others that have have started in the United States and Canada and that is, that we have been so greatly helped throughout nearly the whole of our existence, by the Department of Agriculture for Ontario. (Applause.) We began in a very small and humble way with a little magazine of eight pages that was to be published whenever we had enough material and enough money, and we had fourteen members, all told, when we began. And we managed like many other societies to struggle on, but unlike most societies of this kind, we have not died a natural death in a few years. The Department of Agriculture came to our assistance, and gave us a small grant at first, which was subsequently greatly increased, so that while a number of years

passed, we have been able to hold our own in the domain of science in North America and to spread our publication, not only all over the continent but, we may safely say, to the ends of the earth. We have correspondents and subscribers in every part of the world, including even South America, Australia, India and Japan, as well as the different countries of Europe. I trust you will unite with me in expressing our thanks to Prof. James. (Applause.)

THE VALUE OF ENTOMOLOGY.

Mr. James Fletcher, Entomologist of the Experimental Farm at Ottawa, spoke as follows:

Mr. Chairman, Ladies and Gentlemen,—It is my pleasure and honor on this occasion to represent as well as I can a far better man than myself, namely, the President of our Society. After all the kind words which have fallen from the lips of our esteemed lecturer of the evening, the Deputy Minister of Agriculture, it is difficult to give a resume of the work and objects of the Entomological Society of Ontario without repeating something which may already have been better said. Our Society stands in the position of a Division of Entomology to the Department of Agriculture and Arts, and it is the wish of every member of the council that our work should be of the greatest possible utility to the country at large. The work done in the past has been of an excellent nature, the prosperity and utility of the Society having year by year increased, and I am happy to be able to say that, at the present time, the Society is in a more prosperous condition than it has ever been before. We have a body of active, enthusiastic workers and every equipment for good work—valuable collections of insects, as well as a first-rate botanical collection, a magnificent library, and, in addition, active branches working up not only entomology, but also many other kindred branches of science. The condition of our library is rather remarkable. It is undoubtedly the best library of works on natural history in Canada and one of the best in North America. Now I am quite certain, Mr. Mayor, that the citizens of London are not aware of this fact; they do not know of the valuable collection of books on natural history and the grand museum of insects and plants which are deposited here in their midst, but which specialists are glad to come from all parts of Canada to examine. Some people may say, "What is the use of these collections of insects and plants? They are pretty, it is true, but what is the use of them?" In reply, I would remind such enquirers that these objects are but means to an end. The main object of our Society is to prevent loss to the farmers of Ontario from the attacks of insect pests. The enormous losses which take place in the crops of the province every year from the depredations of injurious insects, can only be controlled by specialists first studying up and understanding the habits of the insects which cause the damage; for this purpose collections of various orders of insects for study and comparison are essentially necessary. Moreover, by collecting and studying all the members of a family, we may frequently anticipate and prevent injury by one species from knowing the habits of an allied member of the same family. We aim then to make our collections as complete as possible and look forward to the time when some day we may have in our cabinets representatives of all the injurious insects which have given trouble in Canada. These are matters of interest to the citizens of London, which place has always been the headquarters of our Society; and my advice to those of you who have not yet found out what treasures you have among you, is to go and find out as soon as possible; it is worth your while, and I can promise you that you will at all times meet with a courteous reception from our Curator, Mr. J. Alston Moffat, who will gladly show the many beautiful objects in his charge to anyone who is interested enough to call upon him.

Some striking instances of the usefulness of the study of entomology have already been well laid before you by Prof. James, and there are numerous others which might be cited. If any proof of the matter were needed, we have merely to think of the large number of official economic entomologists employed by the leading nations of the world,

and to notice how the study of injurious insects is fostered by the most practical people on the globe to-day, the Americans, who indeed were the first to organize a systematic study of practical entomology and fungology. These two branches of knowledge are certainly worthy of much study, for they are the two chief causes of a reduced output, in other words, loss of revenue, in every country of the world.

The losses in the agricultural produce of a country every year due to the ravages of insects are said to be ten per cent. of the whole amount, and there is a further loss of ten per cent. caused by fungi parasitic on plants grown by man as food for himself or his stock. Familiar examples of such parasitic fungi are the black spot of the apple, smut of wheat, oats, barley, etc., grape mildew and potato rot. All of these are diseases which in the past have been the direct cause of the loss of large sums of money, but which now, owing to the studies of specialists, can all be to a large measure controlled by practical methods, cheap, simple and effective, which can be used by every farmer in the country possessed of ordinary intelligence. The same thing is the case with injurious insects. Of those kinds which every year attack our crops and reduce our revenues, by far the larger proportion have been studied out so fully, by men such as those who form the membership of the Entomological Society of Ontario, that at the present time practical remedies are available for all who will take the trouble to ask for them or who have kept themselves posted in the matters which concern vitally the success of their business. But these facts are not appreciated generally by the people most concerned, the agricultural classes. It is an old but true saying:—"We only miss the water when the well runs dry." As a rule, farmers only think of remedies when they find their crops seriously attacked, and they then find that in many cases it is too late to prevent loss. Many of the most successful means of protecting crops are methods of prevention and must be put in practice long before the crop to be protected has reached maturity. The farmers of Canada are much to be envied; for they have advantages not surpassed in any part of the world. Yes, sir; not only have we here the glorious climate and magnificent soil necessary for the production of the best agricultural products; but we have as well wise Governments who are doing everything possible to help us in making our operations successful. We have our most active and useful Department of Agriculture, at Toronto, which publishes every year in its annual report, the latest developments with regard to all subjects brought before the various societies subsidized by the Government; these deal with many different agricultural matters, such as our own Entomological Society of Ontario, the Fruit Growers' Association, the Bee-Keepers' Association, the Sheep and Swine-Breeders' Association, Farmers' Institutes and many others. All of these associations receive grants, and the Government publishes their reports for the good of the farmers of the country. Besides this, we have the Agricultural College at Guelph, a grand institution doing excellent work; and, above all, we have the Dominion Experimental Farm system maintained by the Federal Government, which is constantly at work trying to assist the farmers of Canada by testing and examining all subjects which it is thought may better their position and prospects. The publications of all these institutions are issued free of charge and distributed with a liberal hand. In fact I believe, as I have already said, there is no country in the world where more is being done in a wise way to help farmers than is the case to day in Canada. (Applause.)

Is it not folly then on the part of any man in this country not to apprise himself of these facts and put them in practice? To bring the matter back again abruptly to the work of the Society under whose auspices we are gathered here to-night, is it not folly on the part of any farmer in Canada not to find out what are the latest developments—or, as Prof. James has put it, "what is the new agriculture,"—with regard to the best methods of protecting himself from loss and of saving his crops from the attacks of the hordes of injurious insects which are ready to levy so heavy a tax upon all that he grows?

Many instances might be cited of the good results which have followed the diligent work of entomologists.

Prof. James has already referred to that delightful incident by which the very existence of a lucrative industry, the cultivation of oranges and other citrus fruits in California, was saved from extinction. This was done by the timely introduction from Australia, by the United States Entomologist, Dr. C. V. Riley, of a small parasitic lady-bird beetle (*Vedalia cardinalis*, Muls.) which preyed upon the injurious Fluted Scale *Icerya Purchasi*, Maskell), Fig. 1, an insect which threatened at one time to destroy all the orange groves in the Pacific States. Another instance of good work of particular interest to Ontario farmers, was the practical remedy first hit upon by Mr. L. O. Howard, now U. S. Entomologist, for fighting the Clover-seed Midge. Our farmers in Western Ontario now cut or feed off the first crop of clover about June 20th, to prevent injury to their seed crop by the Clover-seed Midge. This is undoubtedly the best method of preventing loss, but they do not think that the knowledge of that one fact, which is worth at least half a million dollars a year to Canada, was due to the carefully studied investigations of one man. They know nothing of the arduous and unremitting work which was necessary before

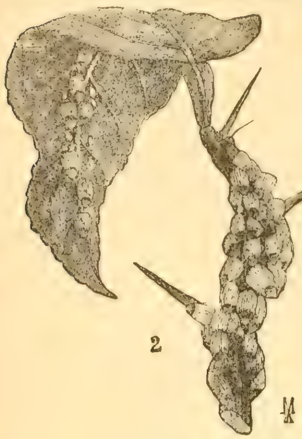

Fig. 1.

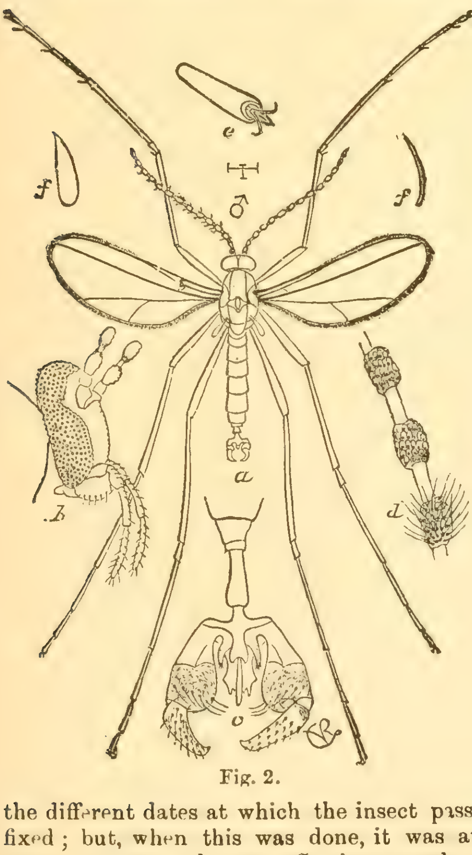

Fig. 2.

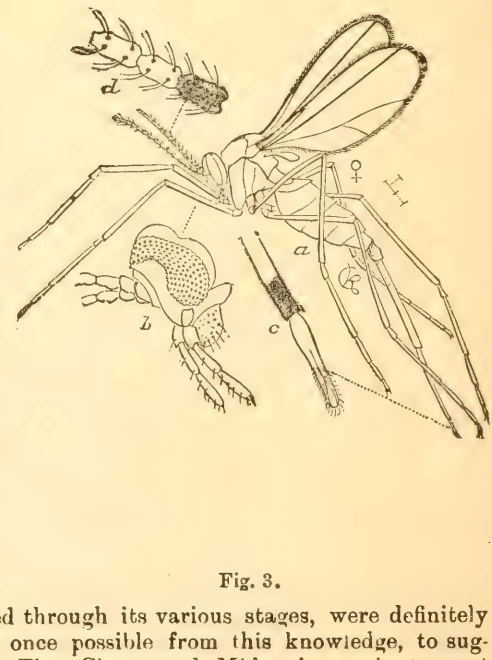

Fig. 3.

the different dates at which the insect passed through its various stages, were definitely fixed; but, when this was done, it was at once possible from this knowledge, to suggest an easy and very effective remedy. The Clover-seed Midge is a minute gnat

(Figs. 2 and 3) which lays its eggs in the forming flower heads of the clover plant in May or early in June and again during July. There are thus two broods of this insect in a season. The larvæ (Fig. 4) of the first brood attain their full growth about the end of June, when they leave the clover heads and go into the ground a short distance to complete their transformations, the perfect flies appearing about the middle of July. The eggs laid by these midges produce the second brood of larvæ which destroy the fall crop of clover seed. Part of this brood matures in September, but the remainder not until the following spring. Experience has taught farmers that the remedy suggested of feeding off their clover fields with cattle and sheep until the beginning or middle of June, or cutting it by the 20th of the same month, is the only way to secure an autumn crop of seed; thus, the grubs of this first brood (the eggs of which were deposited on the growing clover as the heads formed) are destroyed by the cattle eating them, or they dry up with the clover hay which has been cut before they were mature enough to leave the heads of clover and go into the ground to complete their stages. If the clover is left standing in the fields till the end of June, a sufficient time elapses for this latter process to take place, and the perfect flies emerge again just in time to lay their eggs in the opening flowers of the second crop. In this way, the seed of the second crop is destroyed as well as the first.

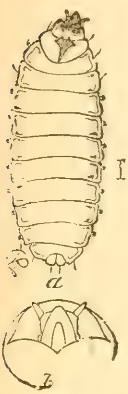
Fig. 4.

Few appreciate the fact that many of the common remedies which have now come to be pretty generally practised all over Canada, were the outcome of much labour and unremitting attention on the part of men who had devoted years of close study to the matter. The farmer who saves his crop of potatoes by dusting or sprinkling them with a mixture containing Paris green, has small thought for the continuous effort and numerous trials which were necessary before the insecticidal properties of this useful substance were discovered. Paris green, the standard remedy against all mandibulate or biting insects, is a chemical combination containing chiefly arsenic and copper, about 60 per cent. of it being arsenic. It is to this latter it owes most of its virtue as an insecticide. It is, I think, almost an ideal material for the purposes to which it is applied by entomologists. The danger of its being mistaken for some other substance of a harmless nature is reduced to a minimum by its characteristic bright green colour, the colour green being very generally recognized as indicative of poisonous properties. Its insolubility in water and under most conditions to which it is likely to be exposed, renders its use very simple, although this fact also necessitates the constant agitation, during their application, of all liquid mixtures containing it, in order that the Paris green, which is very heavy, may be kept in suspension uniformly through the whole liquid. Its fine state of division makes its dilution either with liquids or dry powders very easy, and its extreme virulence as a poison makes it possible to dilute it very much indeed without loss of its efficacy as an insecticide. It has been discovered of late years that, by mixing an equal weight of quick-lime with this arsenite, the caustic effects which sometimes follow its careless use on vegetation, can be in a large measure prevented. This discovery has simplified immensely the question of the most suitable remedy for mandibulate insects; for now a standard strength of one pound of Paris green, one pound of quick-lime and 200 gallons of water may be recommended for use on all kinds of vegetation. If it be thought more convenient to apply the poison in a dry form, it may be mixed with fifty times its quantity of any dry and finely divided powder.

The easiest way of applying Paris green to orchard trees is in a liquid mixture, by means of a force pump with a spraying nozzle. The good results which have followed the adoption of spraying as a regular orchard operation, have been so remarkable that it is now practised by all progressive fruit growers. There are various kinds of spraying

* Fig. 2*a* represents the male midge enormously magnified; *b*, the head, and *c*, the peculiar clasping organs still further magnified; *d*, the joints of the antennæ; *e*. the claws; *f f*, forms of the scales which are distributed over the wings and body. Fig. 3*a*, represents the female midge similarly magnified; *b*, the head; *c*, the tip of the ovipositor; *d*, a portion of one of the antennæ. The small lines beside the figures give the natural size of the midge. Fig. 4*a*, represents the larva; *b*, the head withdrawn into the first segment. These figures are from drawings by the late Prof. C. V. Riley,

pumps and nozzles, and the latter are quite as important as the former. We have now several good pumps manufactured in Canada ; but the best nozzles are the Vermorel and the MacGowan The former is a modification of the Cyclone nozzle, invented by Prof. Riley and his staff, of the United States Division of Entomology ; the principle of this nozzle is that the liquid is forced tangentially into a small chamber, so as to strike the other side of the chamber ; it is then forced through a minute central orifice, which has the effect of breaking up the liquid into a very fine spray. Too much importance cannot be attached to the fact that the liquid must be broken up into as fine a spray as possible, so that a very small quantity of the liquid may be used, and that it may be carried all through the foliage and left as a fine dew on the whole surface. In this way sufficient of the poison is deposited to destroy the insect enemies ; at the same time, little is used, and there is no injury to the foliage.

During the past summer, there has probably been considerably more spraying done than ever before. This is largely due, of course, to efforts that have been made to bring this excellent method of preventing loss to the notice of fruit growers at the proper season. In Ontario much attention was drawn to the subject last year by some experiments carried out by Mr. John Craig, Horticulturist to the Central Experimental Farm, in a few orchards of Western Ontario. These experiments were very much extended and vigorously prosecuted during the past summer by instruction of the Hon John Dryden, Minister of Agriculture, who recognizes fully the value of this work to the province. The operations were put into the efficient hands of Mr. A. H. Pettit, who visited a great number of stations throughout the province, giving instructions and superintending the spraying of the orchards at regular intervals. The full account of this useful work will be published by the Department ; but I many mention that Mr. Pettit has informed me that, on the whole, they have been very satisfactory.

In view of all that has been done by the Government of the country to distribute accurate information as to the best way of preventing injury to fruits by insect and fungous enemies, it certainly is a disgrace to our Canadian fruit growers that apples and other fruits are exposed for sale in this country, and exported to foreign markets in the spotted and blemished condition that is frequently the case. It is disgraceful because it is unnecessary. The two enemies, which are the cause of the greater part of this injury, are the Black Spot, a fungous disease, and the Codling Moth, the larva of which is the well-known "apple worm" Satisfactory remedies for both of these have been found ; the Bordeaux mixture for the former, and Paris green for the latter. The cost of spraying these washes over the trees is very little, compared with the great saving which is made in the quantity and quality of the fruit harvested. Although it is true that the number of different kinds of insects which may attack our crops is very large, the actual number of those which are likely to appear every year is comparatively small ; of these by far the larger proportion have been already studied and remedies have been published in the official reports, which are available for all who ask for them.

Before closing I must refer to one more subject, namely, the Horn-fly of cattle, which, of late years, has done so much harm among our dairy herds, but about which, from knowing the details of its behaviour since it was introduced into America, entomologists were at once able to give encouragement to dairymen, that in a year or two the virulence of its attacks would be much diminished. This prediction, I am glad to say, has proved correct ; while, two years ago, in this very district, the loss in milk supplied to cheese factories was stated to be nearly fifty per cent. of the whole supply, last year it was much less, and during the present season, as far as I can learn, it has been brought down to only five per cent. Next year and thereafter, I hope confidently, that the annoyance from this insect will be reduced so much as to require no more attention than is given to-day to the ordinary cattle fly (*Stomoxys calcitrans*, L.)

Now, Mr. Chairman, I maintain that all this saving, to which I have referred, has been brought about from the development of the *science* of entomology. Science is a terrible word in the eyes of some people ; but, after all, it is merely an illustration of the affectation of the age ; some people like to use long words where short ones would do as well or better, or to use Latin where plain English would do. Science is a Latin word

which means simply knowledge, and it has been given the special signification of exact knowledge, or the best knowledge. I presume this was what Prof. James meant when he explained to us that the new agriculture was simply an outcome of the necessity, now-a-days, for farmers to have the best possible knowledge and education upon all subjects affecting their calling. I feel sure that everyone here was pleased to hear his kind words about the different societies he referred to, and most particularly proud of what he said of the work of this Society. There is no doubt that special knowledge is now necessary for farmers to compete successfully in the struggle of life. I noticed a statement in the newspaper this morning which well illustrates this fact.

Prof. Henry, one of the best known teachers of agriculture, who is at the present time doing good work at the Wisconsin Agricultural College, obtained his position owing to his practical knowledge of all the details of farming. He has always held that the best men and the best knowledge were necessary for successful farming, and used it as an argument for farmers' sons to remain on their farms and study farming in earnest. There was a vacancy at one of the other agricultural colleges for an agriculturist, and, the story goes, that Prof. Henry was asked if he could send a suitable man to fill the post at $1,500 a year. His answer was that he regretted to say that he could not then find a man properly equipped with all the necessary knowledge of farming, but that if it had been a lawyer or a doctor that was required he could send a whole carload at $600 apiece!

Mr. Fletcher resumed his seat amid much applause, and was followed by the Rev. T. W. Fyles, of Quebec, who read the following paper:

HOW THE FOREST IN THE DISTRICT OF BEDFORD WAS SWEPT AWAY,

By Rev. Thomas W. Fyles, F.L.S., South Quebec.

The remarks contained in this paper apply to that hilly section of the Eastern Townships which lies between the Seigniories on the one hand and Lake Memphremagog on the other, more particularly to the counties of Missisquoi, Shefford and Brome. I have known the locality for more than thirty years, and, in the early part of that period, was intimate with many of the first settlers of the district. Originally this was one vast forest, broken here and there by lakes and beaver meadows. The prevailing trees were the pine (*Pinus strobus* Lin.), the hemlock (*Abies Canadensis* Michx), the spruce (*Abies nigra* Poir), the balsam (*Abies balsamea* Marshall), the cedar (*Thuja occidentalis* Lin.), the tamarack (*Larix Americana* Michx), the maple (*Acer saccharinum* Wang), the beech (*Fagus feruginea* Ait), the elm (*Ulmus Americana* Wiild), the basswood (*Tilia Americana* Lin), the white ash (*Fraxinus Americana* Lin), the brown ash (*Fraxinus sambucifolia* Lin.) the birch (*Betula papyracea* Ait), the butternut (*Juglans cinerea* Lin.), the red cherry (*Cerasus Pennsylvanica* Linn), and the black cherry (*Cerasus serotina* Ehrhart). Some spots were named from the nature of the growth which covered them, as Pine Mountain and Spruce Mountain, in Brome.

In early days the staple productions of the district were pot and pearl ashes; and the tree that was found to yield the greatest abundance of these was the elm, and as in those days the law was administered in Montreal, and was an expensive luxury, the early settlers, many of whom were squatters, were allowed to do in the forest very much that which was right in their own eyes. Accordingly regardless of *meum et tuum*, they cut down the elms wherever they could find them, and converted them into "black salts." Consequently the elms of the primeval forest were the first of its trees to disappear. The pines followed next in order. The quality of the timber and the ease with which it was worked brought the white pine into great request. Where there was water transit, as for instance, near Lakes Champlain and Memphremagog, the clearing off of the pine was rapid. And, throughout the district local requirements could be satisfied only with the choicest timber, and all that was not of the best was accounted "vile and

refuse," and was "utterly destroyed." The old court house at Cowansville and the old church at West Shefford, in the soundness and clean grain of the pine lumber employed in them, showed the fastidiousness of their builders' choice of materials.

In the meanwhile, in the struggle for existence, the forest at large was being beaten back; and as Sampson of old said of the Philistines, so the settler might have said of his hacked and dismembered foes, "Heaps upon heaps here they lie!" Blackened piles cumbered the land, to be burned at fitting season, and their remains dragged into new pyres, until, in the language of the people, they were "quite worn out."

The first clearings for actual settlement were made where hardwood timber abounded, for it was well known that hard-wood stumps rot out in seven or eight years, whereas the stumps of black timber endure for a lifetime. The trees that were utilized in the havoc were the white ash, the brown ash and the basswood, which were split into fence rails. Now and then a cherry or a bird's-eye maple found its way to the turner's, to be converted into furniture, but too often indiscriminate destruction made room for the corn field and the potato patch. Often when the maples were spared to form a sugar bush, carelessness and ill-usage insured speedy decay. I frequently saw trees tapped by the acre with slanting gashes a foot long and two or three inches deep, a proceeding which impaired the circulation of the sap, producing a diseased condition of the tree, which, as we shall presently see, was peculiarly inviting to the attacks of injurious insects. Those were the days when stately specimens of the basswood (the lumber of which would now be worth $20 per thousand) were felled and notched into sections, which were split off and roughly shaped into sap troughs, the larger portion of the wood being wasted in the process.

As the clearings were enlarged and the dairy afforded more employment and greater profits, the traffic in "black salts" died out, and a second period in the history of the district may be said to have been reached. A third and striking era was opened when, by the enterprise of the late Hon. A. B. Foster, the railway to Waterloo was completed. Not only did farm produce meet with a readier sale, but a demand for hemlock bark, to supply the southern markets, arose, and men turned their attention more closely to the black timber. The short interval between the hoeing season and hay-time was diligently turned to account in peeling bark—the stripped hemlocks being allowed to lie as they had fallen. In consequence tangled slashes often disfigured the uplands, until a second growth—usually of poplar—hid their deformities.

Hitherto we have considered man's work in stripping the land of its bosky covering, but the elements played no unimportant part towards the same end. Fierce winds from the low-lying "French country," compressed in the valleys and defiles, again and again rushed up the mountain sides, and wherever they found a break formed by new settlements, impinged upon the exposed edges of the forest, and tumbled many goodly trees over, as if some huge monster were rooting amongst them. I know one spot where, for some acres, the trees, after a hurricane, lay in swaths, like grain from the scythe of the mower.

But, if the wind slew its thousands, fire may be said to have slain its ten thousands. The heedless and untimely burning of a brush heap often started a conflagration which extended for miles. One of the first inhabitants of Iron Hill told me that the grandest sight he ever saw was the fire rushing up through the pine woods on the western slope of Brome mountain. In May, 1877, I rode with the late Sheriff Cowan from Cowansville to Philipsburg, and men were pulling down fences and "fighting fire" all along the way. And at Philisburg clouds of smoke, sweeping across Missisquoi bay, told that the fire was raging in the State of New York. Great damage was done to the second growth sugar woods by this conflagration, and for several years after maple wood was *a bon marche.*

In addition to man and the elements, an innumerable yet unobtrusive army of sappers and miners worked upon the forest trees—grubs of beetles and horntails, and caterpillars of moths. I shall speak of but a few kinds that attacked (1) the "black timber," (2) the hard woods, (3) the poplars.

(1) I remember standing in the chancel of a new church which I had built in the township of Brome in 1864, and hearing from the floor a slight rasping sound, I watched attentively, and presently the jaws and head of a Buprestis larva (Fig 5*a* and *c*, the larva and head; *b* pupa, *d* beetle), appeared through a hole. I looked around me and saw that there was a row of holes wherever the flooring rested upon a sleeper, and I found that the sleepers had been made of small spruce and hemlock trees hewn a little on the upper side. These trees were the habitations of Buprestidæ, the larvæ of which, having at this time attained their full growth, had gnawed their way through an inch ot floor-lining, and an inch and a quarter of spruce boarding to the upper air, that they might enter upon the pupal condition satisfied that a way of exit had been secured for the coming imagoes.

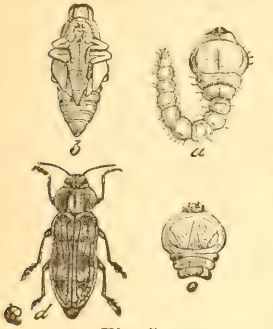

Fig. 5.

There is an insect, a longicorn beetle which, like the "Timberman" of Scotland, finds its food and habitation in the pine. It is *Monohammus Confusor* Kirby (Fig. 6) It is a dark gray, square-hipped insect, an inch and a quarter long, with antennæ of twice that length. This creature often presents itself unexpectedly in strange quarters. One afternoon I was sitting in my study in the rectory at Cowansville, which was then a new building, when suddenly a strange object came down with a great clatter upon the book I was reading. It was *M. confusor*. "Where did you come from?" I said. I locked round and soon discovered a hole recently made in the casing of the door. What an experience that insect had gone through! It had sprung from an egg laid in a crevice of a standing pine. The tree into which it had eaten its way had been cut down, hauled about in the woods, soaked in the mill-pond, and cut up by the circular saw. The boards had been banged about in the piling, had been kiln-dried, and then passed through a planing-machine. That particular board in which the beetle had had its habitation had been worked by hand in "the sash and door factory;" had been planed and fitted, and hammered and painted; and yet--surviving all the rough usage, and escaping all the deadly weapons—there had lain *M. confusor* snugly ensconced in his square-inch, or so, of wood, reserving himself until he could present himself as a gentleman. (Fig. 6.)

Fig. 6.

Another beetle closely related to *M. confusor*, and of similar habits is *Monohammus marmorator* Kirby. It is somewhat smaller than *M. confusor*, and has shorter antennæ. In color it is brown, marbled with pale yellow.

A third insect belonging to the same genus is *Monohammus scutellatus* Say, (Fig. 7). It is called by the French-Canadians, "*Le Forgeron*"—the Blacksmith. It is deep bistre in hue, and has a white scutellum. During the past season (1895) this insect has been unusually numous and destructive. In the spring one of my neighbors planted an extensive hedge of spruce around his grounds. By the end of summer nearly every scion had been girdled or partially so by the *Forgeron*. The larvæ of the species are even more destructive than the perfect beetles. I have seen a fine, large, spruce tree snap off, two feet from the ground, under pressure from the wind, and, on examination, have found that the stem was tunnelled through and through—scores of the Scutellatus larvæ having mined and countermined it in all directions.

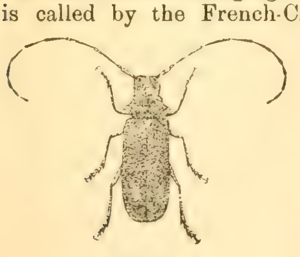

Fig. 7.

(2) The hardwood also affords food and lodging to various insects. The handsome beetle, *Glycobius speciosus* Say (Fig. 8) (whose black and yellow livery is so suggestive of hornets and stings, but is *speciosus* notwithstanding) is frequently found in our woodsheds, having arrived at perfection in the maple, the best of our firewood.


Fig. 8.

But there is a creature that far more extensively assists or accompanies the decay of the hardwood trees. It is one of the Horntails, *Tremex columba* Linnæus—an insect belonging to the order hymenoptera. The female *Tremex* is provided with a strong, black, bristle like ovipositor, which proceeds from the centre of the abdomen, and, when not in use lies extended beneath and beyond that section in a fixed and protecting sheath. In depositing its eggs the creature withdraws the ovipositor from its sheath raises its body and drives the appendage through the bark and into the soft wood, laying its eggs therein. As soon as the young grubs are hatched they begin to tunnel the wood, enlarging the bore as they increase in size. By the end of the first season they attain the dimensions of thread worms. The full grown larva is an inch and a half in length and has a waxen appearance. Its mandibles have a ferruginous tinge and its spiracles are light brown. The prop-legs are imperfect and the body terminates in a short spine.

Long observation has led me to believe that the Horn-tails and other borers do not attack *sound and healthy trees.* I stated this belief in a lecture I gave in the Somerville course some years ago. Since then I have read the Rev. J. G. Wood's "Insects at Home," and I am glad to find that some remarks of his bear out my statement. Speaking of the dreaded *Scolytus destructor* Olivier of Europe he says :—

"It is much doubted whether the Scolytus ever attacks a healthy tree, principally, as is conjectured because in such trees the burrows of the insects are filled with sap which not only drives out the beetles but prevents their eggs from being hatched. Still when a tree becomes unhealthy the attacks of the Scolytus prevent it from recovering itself," etc.

A tree struck by lightning, or broken by the wind, or scorched by fire, or hacked and abused by man is the chosen object of insect spoilers.


Fig. 9.


Fig. 10.

I have spoken of the waste of hemlock which followed upon the first demands for tanbark. Felled hemlock trees that are not soon sent to the sawyer's, are sure to be confiscated by a sawyer of another kind, *Prionus unicolor*, as Harris calls it—the one-coloured sawyer—the *Orthosoma brunneum* of Forster. (Fig. 9.) For nature not only abhors a vacuum ; she also abhors waste. A standing hemlock in the last stage of its existence

produces the *Boletus igniarius* which nourishes the Toad Beetle, *Boletophagus corticola*, Say. A fallen hemlock becomes the food of the Prionus grubs. (Fig. 10.) The creatures are well known to every farmer who has had to clear his land of the half rotten trophies of his early triumphs over the wilderness.

It yet remains for me to say a few words (3) concerning a borer which attacks the poplars, the latest growth on neglected brush lands. The insect is *Cossus centerensis*, Lintner. It belongs to the order lepidoptera. The perfect insect is a large moth with crape-like wings, dark grey in colour, reticulated with fine black lines. It makes its appearance in July. The male is smaller than the female. The presence of the larva is betrayed by the *frass*, or half digested sawdust, which it throws out, in early summer, from its burrow in the tree. On attaining its full size, the caterpillar retires some inches into the tree, and assumes its chrysalis condition. In due time, the chrysalis, by means of a series of serrated rings on its body, works it way along the tunnel bored by the larva, to the surface of the tree, and forces itself through, so as to clear its wing cases. The skin then bursts, and the perfect insect makes its escape.

In bringing this brief history to a conclusion I would bear in mind that the aim of all historians should be to convert the mistakes of the past into lessons for the future; and I would offer a few practical hints :—

I. Believing in the powers of the press, I would commend to all newspaper editors the practice of devoting a column to the discussion of rural affairs. Under a judicious editor the practice is invaluable, for many men in country places read the newspaper, and read little else.

II. In all normal and training schools, teachers should be led to see the importance of training the young in habits of prudence, forethought and economy For want of the exercise of such qualities in his early days many a farmer has now to buy his firewood, or to obtain it from a distance at the expense of much time and labour.

III. I would recommend farmers to thin out their sugar woods, plantations and copses, so that the trees may have ample room to spread their roots and obtain a firm hold on the earth, that they may not easily be overturned by a tempest.

IV. I should say, do not over-prune, and prune in the winter when the sap has ceased to work. Cover all wounds with grafting wax or oil-paint. Neglect of these precautions will throw the trees into a condition which will assuredly invite the attacks of destructive insects.

Lastly, I should say, tap your maple trees with care; use a duck-bill augur and cedar spouts, which "give" and do not split the bark.

A cordial vote of thanks to the Mayor, for his kindness in presiding on the occasion and allowing the use of the city hall for the meeting, was proposed by Mr. Dearness, who spoke very happily of the pleasure and instruction which they had all received from the addresses of the evening, and was seconded by Mr. Saunders, and adopted by the meeting with much applause.

Mr. E. R. Cameron then moved, seconded by Mr. S. H. Craig, a vote of thanks to the speakers who had come from a distance to address them, and had afforded them so much gratification. After putting the motion, the meeting was closed with a few pleasant remarks from the Mayor, who wished the Entomological Society of Ontario a long continued and prosperous career.

THURSDAY, NOVEMBER 28TH.—MORNING SESSION.

The meeting was called to order at 10 o'clock, a.m., the chair being taken by Mr. Fletcher. The reports of the various sections of the Society were presented and read by their respective secretaries.

REPORT OF THE BOTANICAL SECTION.

The Botanical Section beg to submit the following report for the summer of 1895:

Regular weekly meetings of the section were held from April 22nd to October 19th. The average attendance was considerably in advance of that of the previous year. A number of the public school teachers of the city joined the Society, and became industrious workers in our section. For the benefit of those just beginning the study of botany, a part of each meeting was devoted to the study of some important natural order, illustrated by typical specimens collected by the members.

Papers upon the following subjects were read at different meetings:

1. "The Humanity or Civilization of Plants and Flowers," Prof. J. H. Bowman.

2. "The Relation of Chlorophyll to the Forms of Plants," W. T. McClement.

3. "The Distribution of Plants in Ontario, with Special Reference to the London District," Mr. J. A. Balkwill.

4. "The Dissemination of Seeds," W. T. McClement.

One public field day was held, July 1st, when the members and their friends visited Komoka, and made large and beautiful collections, the feature of the day being the abundance of *Cypripedium spectabile.*

During the season the following plants were added to the local list:

Spergula arvensis—Mr. J. A. Balkwill.

Arctostaphylos Uva-ursi—Prof. J. Dearness.

The section have deemed it wise to direct their attention to the arrangement of a Flora of Middlesex county. A good start has been made toward this, as we have the list of *Polypetalous* and *Gamopetalous Exogens* ready for final revision. We have to thank Mr. Fletcher for a number of rare and interesting plants from the Ottawa district, which he donated to the Herbarium.

W. T. McClement, Secretary.

Mr. Fletcher spoke of the value of the proposed Flora of the County of Middlesex. He also stated that *Spergula arvensis*, which had recently been found in the neighborhood of London, was recommended by the Michigan State Agricultural College for introduction as a fodder plant, but in Europe it was regarded as a persistent and troublesome weed, and was found to bear the same character in some parts of Canada. He strongly deprecated its introduction by farmers into this country.

REPORT OF THE GEOLOGICAL SECTION OF THE ENTOMOLOGICAL SOCIETY FOR THE YEAR 1894-95.

We have much pleasure in reporting to your honorable body that the Geological Section has had a most prosperous year. Our membership has increased; the average attendance at our meetings has been greater than during any previous year.

Many valuable additions have been made to our private collections since last we reported progress, but we are still looking forward to the formation of a central collection in our city, to which the members of our Society and all our citizens may have free access.

The section would suggest that it would be a great advantage to students of mineralogy if some steps could be taken by which the small number of Geological and Natural History societies in the Province could be provided with small collections of accurately named specimens of the chief economic minerals.

The members of our section have made trips to a number of places of geological interest, including Rockwood, Elora, Guelph, North Dorchester, and the mammoth and colossal Caves of Kentucky.

Valuable papers have been read before our section, showing the methods of gold mining in Australia, Colorado, Ecquador and Madoc.

Addresses on the following subjects have been made by various members of our Society:

1 "Trip to St. Joseph's Island." By Mr. Morris.

2. "Australian Gold Fields," Mr. Webb.

3. "Crystallography," Dr. Wilson.

4. "Canoe Cruise on Lake Nipissing," Mr. Allison.

5. "Physical Basis of Knowledge," Mr. Scarrow.

6. "Correlation of Forces," Mr. B. Green.

7. "Trip to Mammoth Cave," Dr. Wolverton.

Signed on behalf of the Geological Section by

G. F. Sherwood, Secretary. S. Woolverton, Chairman.

REPORT OF THE MICROSCOPICAL SECTION OF THE ENTOMOLOGICAL SOCIETY.

The season opened with the first meeting on October 12th, and continued every second week till March 29th, at which time, as is usual, we discontinued in favour of the Botanical Section, of which nearly all the microscopists are active members.

Regular Meetings.—There have been twelve such. Interest has been well sustained throughout the season, meetings regular, attendance good, subjects excellent and well presented. More than usual the members have engaged in practical work. Among the subjects were: "The Study, Dissection and Mounting of Earthworms," led by Dr. Hotson; "Fungi" (Hymenomycetes), and "Wood Sectioning, Staining and Mounting," led by Prof. Dearness; "Insect Mounting Without Pressure," also "Cell Building," by Mr. Rennie; "Brownian Movement," led by Mr. W. T. McClement; "Fluid Mounting of Green Algæ," also "Collection and Mounting of Diatoms," led by Jas. H. Bowman. Very many microscopical plants were brought in by members and furnished many an enjoyable hour.

Open Meetings.—Of these, two were held, and, as usual, attracted a large attendance and were well appreciated by those for whom they were intended. In this connection we would say that we find our present quarters very ill-suited for this class of meeting. Had we held the same in some more convenient place, no doubt a great and favorable difference would be observed.

Outings.—These are not so frequent as they might, and would be, if it were not that we occupy only winter months. We have, however, the benefit of the botanists' excursions in the summer time as our members who are botanists are always thinking of our section and preserve their finds and work up their subject in connection with them for our meeting season.

Jas. H. Bowman,
Secretary of Section.

REPORT FROM THE ENTOMOLOGICAL SOCIETY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA.

By the Rev. Thomas W. Fyles, F.L.S., Delegate.

I beg to state respectfully that the Society I have the honour to serve on this important occasion, is in a healthy and growing condition—sound financially, possessing a large amount of *materiel*, and held in estimation at home and abroad.

It is to be expected that the subject of economic entomology will commend itself more and more amongst the intelligent members of a fruit growing and agricultural community. The insect enemies of the farmer and gardener are numerous and persevering, and accomplish incalculable harm ; and a society that studies the life histories of these foes, and searches for checks upon their efforts, can hardly fail to win adherents and to command support. Accordingly we find that at the thirty-second annual meeting of our Society the council was able to congratulate the members upon "the steady increase in numbers which continued to take place, and the hearty interest that was maintained in the various departments of the Society's work."

The headquarters of the association are in London, the chief town of one of the mo important agricultural and horticultural sections of Ontario, and a fitting centre for a society which is aided by the Ontario Government, and is intended to promulgate practical information amongst the cultivators of the soil, as well as to foster scientific research. The Government grant made to the Society annually is $1,000.

That the Society is doing the work expected from it, and doing it well, may be shewn on sufficient testimony. Thus Mr. L O. Howard, Chief Entomologist of the Department of Agriculture, Washington, says of it : "The Society has conscientiously complied with the conditions of the grant. Its reports published annually have greatly increased in size, and in the general interest of their contents. They have contained much matter of economic value as well as of educational interest." And the editor of an English magazine speaks of the report last issued as one of more interest to him than all others received from America. Doubtless the Society, with a larger grant, could accomplish more good.

The annual meeting, to which I have referred, was held on the seventh and eighth days of November last. The value of the addresses and of the papers read, and the beauty and rarity of the specimens exhibited on this occasion were fully appreciated by those who were privileged to attend. The President's address was particularly valuable as an instructive sketch, *historical* and *geographical*, of the Society and its work. It was learnt from it that the society has observers and correspondents from east to west throughout this vast Dominion—from St. John, N. B , and Halifax, N. S., to Esquimalt in British Columbia and Masset in Queen Charlotte Islands. A very valuable paper on "The Rhopolocera of the Eastern Provinces of Canada," was read on this occasion by the Rev. Dr. Bethune, editor of the *Canadian Entomologist* It gave a complete list of species and the names of the localities in which each local kind has been taken with—as far as is known—the food plants of the different species.

The titles of the other papers read at the meeting are as follows :—

"Insects Collected in Bermuda During the Winter of 1894," by Gamble Geddes, Toronto.

"Common Names for Butterflies—Shall We Have Them?" by H. H. Lyman, Montreal.

"The Pitcher-Plant Moth," by James Fletcher, Ottawa.

"Catastega aceriella *Clemens*, Semasia signatana *Clemens*," by the Rev. Thomas W. Fyles, South Quebec.

"Notes on a Few Canadian Coleoptera," by W. Hague Harrington, F.R.S.C., Ottawa.

"Food, Feeders, and Fed," by Rev. Thomas W. Fyles, F.L.S., South Quebec.

"An Attack of Ephestia interpunctella," by H. A. Stevenson, London.

"The Economic Value of Parasitism," by F. M. Webster.

"The Re appearance of Pieris Protodice *Boisd.*," by J. Alston Moffat, London, Ont.

"Remarks on the Structure of the Undeveloped Wings of the Saturniidæ," by J. Alston Moffat.

"Bordeaux Mixture as a Deterrent Against the Flea Beetles," by L. R. Jones, Burlington, Vermont.

"The Gypsy Moth," by James Fletcher, Ottawa.

'The San Jose Scale," by James Fletcher, Ottawa.

"Injurious Fruit Insects of the Year 1894," by James Fletcher, Ottawa.

The twenty-fifth annual report, issued by the Society, contains portraits of Professor William Saunders, F.R.S.C., President of the Society from 1875 to 1886, and Augustus Radcliffe Grote, A.M., one of the Society's honorary members, and it is also illustrated with sixty figures of insects.

Besides the President's address and the papers above-mentioned, the report contains .—

The minutes of the meeting.

The Report of the Librarian and Curator, Mr. J. Alston Moffat.

The Report of the Montreal Branch, presented by Mr. H. H. Lyman, President, and signed by Mr. A. F. Winn, Secretary.

The Report of the Geological Section, presented by Dr. S. Woolverton, Vice-Chairman.

The Report of the Botanical Section, presented by Mr. W. F. McClement, Secretary.

The Report of the Delegate to the Royal Society of Canada.

A very valuable abstract of the proceedings of the sixth annual meeting of the Association of Economic Entomologists, supplied by Mr. L. O. Howard, Entomologist of the Department of Agriculture, Washington, and Mr. C. L Marlatt, Secretary of the meeting; and a number of interesting notices, critical, biographical, etc.

This report is distributed "not only to our own members, but to every member of the Fruit Growers' Association, to members of Parliament, the Mechanics' Institutes, etc., making an issue of 6,000 copies, (W. H. Harrington, *Canadian Entomologist*, vol. XXVI., p. 2.)

The Society's library now numbers 1,361 volumes—seventy-seven having been added in the course of the year.

Important additions have been made to the Society's collections of insects. In its cabinets may now be seen representatives of 1,077 species duly classified and named.

The Society is fortunate in retaining the services of Mr. J. Alston Moffat as Librarian and Curator. By his methodical habits, his manual skill in mounting specimens, and his extensive knowledge of the lepidoptera, Mr. Moffat is peculiarly fitted for the position he holds.

During the year the various sections of the Society have held field days at St. Mary's, Dorchester, Kilworth, Byron, Komoka, Kettle Point (Lake Huron), Ilderton, Thedford, Beechville, Woodstock, Mud Lake and other places. The value from an educational point of view of such expeditions in a neighborhood that possesses such experienced scientific guides and instructors as Messrs. W. E. Saunders, J. M. Denton, J. A. Balkwill, J. W. Dearness, J. H, Bowman, Dr. S. Wolverton, R. W. Rennie, all long connected with the Society, besides younger and enthusiastic men, is beyond estimation.

The *Canadian Entomologist* has reached its twenty-seventh year. The volume for 1894 contains articles from sixty-one contributors—fourteen residing in Canada, forty in the United States, five in England, one in Germany and one in Sweden. In its pages are described no less than seven new genera and ninety-five new species of insects. The magazine continues under the able management of the Rev. C. J. S. Bethune, D.C.L., F.R.S.C., etc.; and it is a striking proof of the courage and perseverance of its editor that notwithstanding the cares and anxieties that must have thronged him, through the destruction by fire of his noble school buildings and the beautiful chapel attached to them, the *Canadian Entomologist* has made its appearance as regularly as ever and as carefully edited.

Hitherto the Entomological Society of Ontario has studied the life-histories of insects, the methods of attack of the pests of the homestead, the storehouse, the garden, the orchard, the field and the forest; the ways for circumventing these foes; and the nature and application of insecticides. Much, no doubt, remains to be learned on all these subjects. But the attention of naturalists has of late been drawn to a new and most important matter. It is, to use the heading of one of the papers published in the Society's report that has been mentioned, *The Economic Value of Parasitism.* It is well to know how to meet enemies ourselves, but it is better sometimes to know how to direct faithful allies against them. If the parasite (*Diplosis grassator* Fyles), which keeps down the numbers of the Philloxera in this country, had been carried over to Europe, it would doubtless have saved many a vineyard that has disappeared. The introduction of the Australian Lady-bird (*Vedalia cardinalis* Mulsant), the foe of the "Fluted Scale," has probably saved the orange groves of California from extinction. The predaceous beetle (*Clerus formicarius* Linnæus) has lately been introduced into Western Virginia by Professor Hopkins, as a check upon the "Borers" that have wrought such destruction in the spruce forests of that country, And this bringing about of good by the directing of insect agents is only in its beginning. As our knowledge increases we shall in all probability be able to gather and control forces that at present are but little understood.

Election of Officers.

The following gentlemen were elected officers for the ensuing year:

President—J. W. Dearness, London.

Vice-President—H. H. Lyman, Montreal.

Secretary—W. E. Saunders, London.

Treasurer—J. A. Balkwill, London.

Directors—Division 1. James Fletcher, F.L.S., F.R.S.C., Ottawa.
" 2. Rev. C. J. S. Bethune, F.R.S.C., Port Hope.
" 3. Gamble Geddes, Toronto.
" 4. A. H. Kilman, Ridgeway.
" 5. R. W. Rennie, London.

Librarian and Curator—J. Alston Moffat, London.

Editor of the "Canadian Entomologist"—Rev. C. J. S. Bethune, M.A., D.C.L., Port Hope.

Editing Committee—J. Fletcher, Ottawa; H. H. Lyman, Montreal; Rev. T. W. Fyles, South Quebec; J. M. Denton, London.

Delegate to the Royal Society—J. D. Evans, Trenton.

Committee on Field Days—Dr. Woolverton, Messrs. Sherwood, McClement, Balkwill, W. Stevenson, W. E. Saunders, Anderson, Elliott, Rennie, and Bowman, London.

Auditors—J. M. Denton and J. H. Bowman, London.

FIELD DAYS.

A discussion on Field Days and the best methods of conducting them was participated in by most of the members present. Mr. Fletcher described the plan adopted by the Field Naturalists' Club of Ottawa, which had proved very successful. It was decided that every effort should be made next summer to develope the system and that the annual meeting of the Society should, if possible, be held in August in order to have a general outing for the members in connection with it.

THE CANADIAN ENTOMOLOGIST.

A discussion was next carried on by Messrs. Balkwill, Rennie, Dearness, and Fletcher as to the possibility of reducing the expense incurred in the publication of the *Canadian Entomologist.* The treasurer and editor were instructed to confer with the publishers on the subject. Mr. Dearness suggested that a leaflet should be printed for enclosure in correspondence, setting forth the advantages of membership in the Society.

AFTERNOON SESSION.

The meeting was called to order by the President, Mr. J. W. Dearness, at 3 o'clock, p.m.

Papers were presented by Mr. Moffat on "Observations on the Season of 1895," "Variation, with Special Reference to Insects," and "The Growth of the Wings of a Luna Moth."

Mr. Fletcher gave an interesting address on his trip to British Columbia during the past summer, which was undertaken for the purpose of collecting and observing insects and plants throughout the region traversed. He illustrated his remarks by exhibiting a beautiful collection of dried plants that he had made, and several boxes of rare and remarkable insects.

A fine specimen of the exceedingly rare elater, *Sarpedon scabrosus*, was exhibited by Mr. J. D. Evans, who had taken it during the past summer at Trenton, Ont.

The receipt of valuable donations to the Society's collection of insects was announced from the Rev. G. W. Taylor, Nanaimo, B.C., Mr. E. Firmstone Heath, the Hermitage, Cartwright, Manitoba, and C. de Blois Green, Osoyoos, B.C., and the hearty thanks of the Society were accorded to the donors. Dr. Bethune stated that arrangements had been made for the exchange of publications from the year 1868 with the Entomological Society of France, whose "Annals" would form a very important and valuable addition to the library.

Much time was very enjoyably spent by the members during both the days of meeting in exhibiting rare captures, examining the cabinets and books of the Society, and comparing notes on many interesting entomological subjects.

INSECT INJURIES OF THE YEAR 1895.

By JAMES FLETCHER, OTTAWA.

The insect injuries to the crops of the province during the past season have been almost entirely by well-known pests.

Cereals.—Grain crops have suffered very little; the most serious injuries were by "grasshoppers." These developed in large numbers all through those districts where

drought prevailed, and did much harm to grass, oats and barley. The species which were most abundant were *Melanoplus femur-rubrum*, *M. atlanis* and *M. bivittatus*. Cutworms (Fig. 11) were less complained of than usual, taking the province as a whole. *Hadena arctica* and *Hadena devastatrix* occurred abundantly in the extreme western counties. Hessian fly was sent in from the Muskoka district; and also the joint worm (*Isosoma hordei*), Fig. 12, the latter attacking wheat and injuring it to the extent of five per cent. at Meaford, Ont.

Fig. 11.

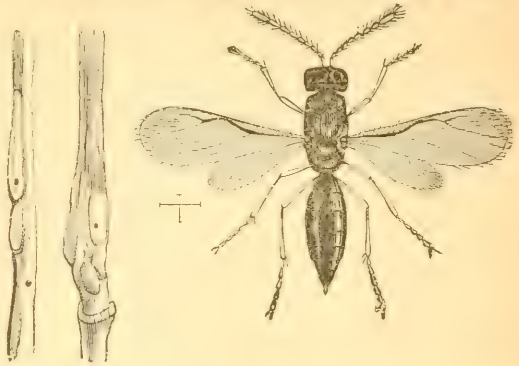

Fig. 12.

Fodder Plants.—Under this head, undoubtedly the greatest damage was done by grasshoppers, and farmers will do well next season to examine their grass lands early in the season before the grass is too high, to see if there are many of the young, and if so, to use one of the different "hopper-dozers" or oil pans which are used to such good effect in the Western States. The Pea Moth has continued its injuries, and up to the present no practical remedy has been discovered. I commend this insect to the particular attention of our members. Although known as so abundant and injurious for the past twenty years, the perfect insect in this country has never yet been identified.

Roots.—The Colorado Potato-beetle still exists in great numbers, but with so cheap and effective a remedy as Paris green, it cannot be considered a serious enemy except by the lazy or careless. The larva of *Gortyna cataphracta* was sent in from three or four places in Eastern Ontario as having bored into the stalks of potatoes, tomatoes and many other garden plants. A new attack on potatoes reported this year for the first time was by *Otiorhynchus ovatus*, which was sent from Fenella, Ont., by Mr. J. B. Brook, who had found it girdling the stems of his potatoes. The same insect was found injuring young apples, pears and currants at Arthabaskaville, Que. Turnips were badly attacked all over the province by the Turnip Aphis, and many reports were received. There is no very satisfactory remedy for this insect. Careful watch should be kept in August when hoeing and thinning turnips. At that time the colonies are small and few in number, and if care be taken to destroy them then, much may be done to control the outbreak. Spraying with kerosene emulsion was found to be useful when the colonies were not too numerous. A tobacco and soap wash would be equally effective. The Diamond-back Moth (*Plutella cruciferarum*) was also abundant both on turnips and cabbages, but affected the crop very little. Cabbage and Onion Root-maggots were as usual abundant in many places, and did much harm. The Imported White Cabbage Butterfly (*Pieris rapæ*), Fig. 13, is not now considered a very serious enemy where the use of pyrethrum powder and flour (one to four) is practised. The best way to apply the remedy is to dust it over the cabbages as soon as the work of the larvæ is noticed, by means of small hand bellows or from a muslin bag. It cannot be too strongly insisted upon that Paris green must never be used on cabbages.

Fig. 13.

Fruits.—The injuries to fruits cannot be said, as compared with other years, to have been very serious. Most of the usual pests have put in an appearance and done some harm, but the more general adoption of the excellent practice of spraying regularly is having a noticeable

effect. Codling moth, Plum curculio, Canker-worm, Eye-spotted Bud-moth, Tent caterpillars and Fall Web-worm have been abundant in some places, but their numbers have been brought down considerably wherever spraying with the arsenites was resorted to.

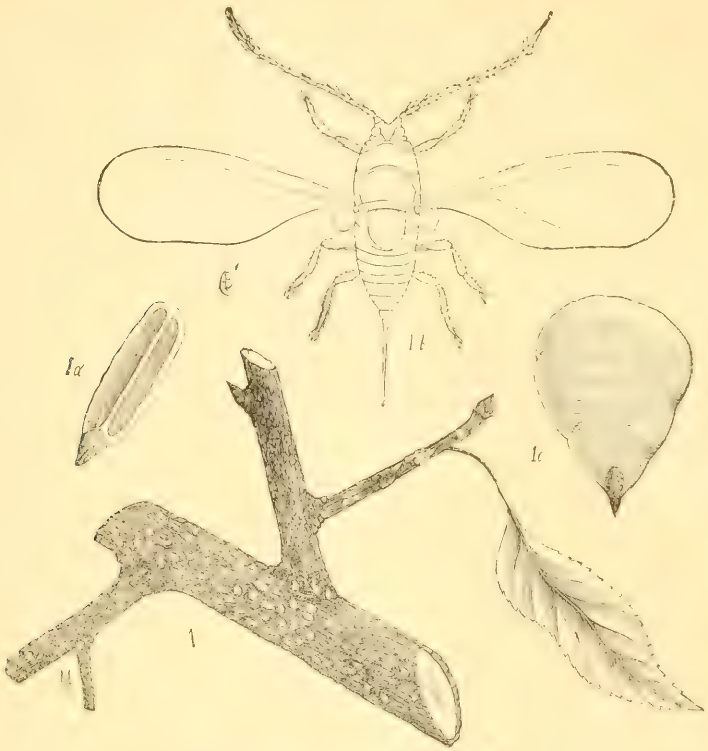

Fig. 14.—1, twig with scales; 1*a*, scale of male; 1*b*, winged male; 1*c*, scale of female—highly magnified.

The Oyster-Shell Bark-louse is abundant throughout the province, and where orchards are neglected does much harm. Spraying with kerosene emulsion when the young insects emerge from the old scales, about 1st June, is the best remedy. The Scurfy Bark-louse, *Chionaspis furfurus*, Fig. 14, was sent from Essex County. One tree was badly infested, but a thorough spraying with kerosene emulsion entirely cleaned it.

The New York Plum-scale (*Lecanium*) has been found, on enquiry, to be present to some extent all through the Niagara peninsula and in some other western counties. Only two bad occurrences have been discovered, and I am much pleased to be able to report that these have both been eradicated by treatment with kerosene emulsion. The life-history of this scale is quite different from that of the Oyster-Shell Bark-louse. In this species, the young emerge at the end of June and make their way out on to the foliage, where they remain without growing much until autumn; they then crawl back again on to the twigs and branches and hibernate there. When revived by the return of spring, they move again and fix themselves to the young wood, chiefly on the lower side of the smaller branches. They grow very rapidly in spring, and the tiny flat scales which hibernated, soon become large, conspicuous, dark brown, hemispherical scales, varying somewhat in size, but about one-eighth to one-sixth of an inch in length by about half of that length in height. The basal outline is ovate or almost round, being very nearly as wide as long. This insect has been carefully studied by Mr. Slingerland of Cornell University, and the remedy which he suggested has been used very satisfactorily both at Queenston and Grimsby, where the two serious outbreaks referred to above occurred.

This treatment is to spray infested trees at least twice during the winter with a strong kerosene emulsion wash—the Riley-Hubbard emulsion diluted with only four parts of water. This did no harm to the plum trees, but quite destroyed the scales.

Canker-worms (*Anisopteryx*). There has been a good deal of enquiry during the past season as to the best way to treat Canker-worms in orchards There can be no doubt about the superiority of spraying with Paris-green over all other methods, where the trees are small enough to be reached easily with an ordinary spraying nozzle; but where trees are old and large, some growers still prefer to use the old method of banding the trunks of the trees with printers' ink and oil or some other viscid material. Mr. O. T. Springer, of Burlington, Ont., uses a mixture consisting of castor oil, two pounds and resin, three pounds, heated and thoroughly mixed. This is painted directly on the tree trunks in autumn and spring. In Nova Scotia, printers' ink is reduced with fish oil, and this is painted on strips of thick paper which have been previously tacked round the trunks. Mr. E. J. Armstrong, of Church Street, Cornwallis, in the Annapolis valley, informed me, when enquiring why he preferred banding to spraying, that the chief reasons were that the trees in Nova Scotia were large, and it was the practice to grow other crops in the orchards, and, besides, injury had been done by careless spraying. He gives the cost of this treatment about as follows: Printers' ink is about twelve cents a pound; twenty pounds of ink will require four gallons of fish oil, at fifty cents a gallon. This amount will answer for an orchard of five acres, the trees being of about twenty or thirty years. It will require about fifteen pounds of paper, at four cents a pound. This is cut with a saw from the roll in strips six inches in width. Two men, armed with a sharp knife and a tack hammer, can go over an orchard of five acres in half a day, the first man measuring the tree and cutting off sufficient paper to band it, the second one tacking it on. The ink is applied in autumn and spring with a paint brush, and the paper put on in autumn is ready for the next spring.

The Cigar Case-bearer (*Coleophora Fletcherella*), which has done so much harm to apples in Ontario and Nova Scotia during the past four or five years, and of which I spoke last year, has been the cause of much loss again this year. Spraying with kerosene emulsion, directly the young caterpillars begin to move out on to the buds in spring and spraying regularly two or three times at short intervals of four or five days with Paris green, one pound to 200 gallons, have both been attended with a measure of success; but this is an exceedingly difficult insect to destroy, owing to the fact that the caterpillar feeds mostly on the inside tissues of the leaf, merely eating a small hole through the outside skin so as to get at the inner tissues, which it mines out in a large blotch mine as far as it can extend its body from its case. Mr. Edwin Worden, of Oshawa, has, during the past summer, sprayed his trees with a Paris green and lye wash, which he writes me has been most satisfactory. The first time he used this remedy he sprayed with concentrated lye only. This was about the middle of May, 1894, and Mr. Worden was under the impression that the application had not killed many of the Case-bearers; but the effect was very beneficial, and he could see distinctly where the spraying had been done by the cleanness of the trees from moss and Oyster-Shell Bark-louse. Last summer he sprayed again with three cans of concentrated lye and one quarter pound Paris green in forty-five gallons of water, and secured the best of results; he particularly states that the lye did not injure the foliage at all. This spraying was done in the beginning of June, and Mr. Worden's object was to destroy at the same time the Codling Moth, the Cigar Case-bearer and the Oyster-Shell Bark-louse. No doubt many other pests would be killed at the same time, such as the Canker-worm, Eye-spotted Bud-moth, Leaf Rollers, etc.

The Peach Bark-borer (*Phlœotribus liminaris*) which has for some years done so much harm in the peach orchards of the Niagara Peninsula, has this year been successfully treated by Mr. O. E. Fisher, of Queenston. Noticing that the perfect beetles became active very early in the spring, he washed his trees then with a strong alkaline wash to which carbolic acid had been added. He made his wash as follows: Five pounds of washing soda, three quarts of soft soap, and enough water to make six gallons. Air-slaked lime was then added sufficient to make it of the consistency of thick paint. To all this was added three tablespoonfuls of Paris green and one ounce of carbolic acid.

This mixture was applied with a whitewash brush, thoroughly covering the entire trunk of the tree and a few inches up on the limbs. Mr. Fisher reports that at the end of the season he is quite satisfied with the results of the treatment. It would appear from what I have just said that two applications of this mixture, the first one being made as soon as the beetles become active, sometimes as early as March, and another six weeks later, would provide us with an effective remedy for this little pest, which for some years has done considerable harm in our Canadian peach orchards.

Black Peach Aphis (*Aphis persicæ-niger*).—The only new fruit pest of any importance which has appeared in the province during the past season is the Black Peach Aphis, of which specimens have been sent in from two orchards at Leamington, in Essex county. The insect has undoubtedly been imported from the United States on young nursery stock. There are two forms of this insect, one attacking the twigs, the other, more injurious and much more difficult to treat, occurring on the roots. Prof. John B. Smith, of New Brunswick, N. J., who has studied this Aphis a great deal, states that the form on the twigs is easily controlled with kerosene emulsion; and the underground form he has successfully treated with heavy top dressings of kainit. He recommends for light soils in New Jersey about ten pounds per tree, covering the probable extent of the root system, This is for a bearing tree from four to six inches in diameter, and the time for applying the kainit is in the spring, when the trees are leafing out. Prof. Smith states that "the kainit has proved successful in our orchards, wherever used." Another method of treatment which has been recommended is to dig in tobacco waste around the roots.

Fig. 15.

Fig. 16.

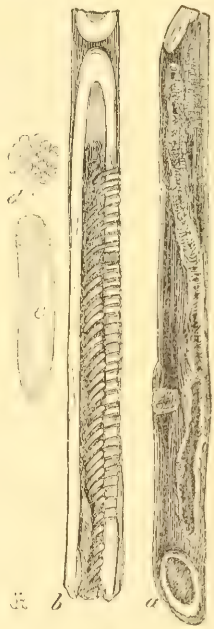

Fig. 17.

Fig. 15, male; 16, female; 17, injured canes.

Mr. Woolverton, the energetic Secretary of our sister society, the Fruit Growers' Association of Ontario, states that the Pear Leaf Blister Mite (*Phytoptus pyri*) is rapidly gaining ground in the Niagara district, the corky dark-colored galls being conspicuous on the foliage of most pear trees. On account of the diminutive size of the mite which causes these blister-like galls and from the fact that it works inside them out of sight, it is seldom recognized as the cause of the injury, many people attributing the origin of the galls to

some parasitic fungus. The treatment which has been recommended for this pest is spraying the trees with kerosene emulsion just as the buds burst in spring. On the Pacific Coast, where it is also very prevalent, good results have been obtained with a winter wash consisting of sulphur one pound, lime two pounds, salt one pound, and water three gallons. The manufacture of this wash is described in detail in an article on the San Jose Scale published in our last annual report.

The Snowy Tree-Cricket (*Œcanthus niveus*), or one of the allied species, is doing much harm in raspberry plantations about Hamilton. Several specimens of injured canes have been sent to me which had been pierced by the females when depositing their eggs. Some of these had split open down the whole length of the punctured area, and the canes in all cases were much weakened. This insect is claimed to be predaceous, and Miss Mary Murtfeldt, who I think was the first to observe this fact, says that they feed almost entirely upon Aphides and other minute pests and make ample compensation for all the injury that they do, and that they should be considered beneficial rather than injurious. Around Hamilton, however, I am told by Mr. Wm. McEvoy, of Woodburn, Ont., that the injuries to raspberry canes are serious. The only remedy which seems practicable is the pruning and burning of the injured canes early in spring before the eggs hatch, for the insect passes the winter in the egg state inside the canes. Figs. 15, 16 and 17.

The insects I have mentioned I think will include all the worst enemies which have been brought before my notice during the season as having occurred injuriously in the province. There were, of course, several others, but none requiring special mention, except, perhaps, the Carpet Beetle (*Anthrenus scrophulariæ*), Fig. 18, which is gradually extending its range, and the Mediterranean Flour Moth (*Ephestia Kühniella*), Fig. 19, for which a

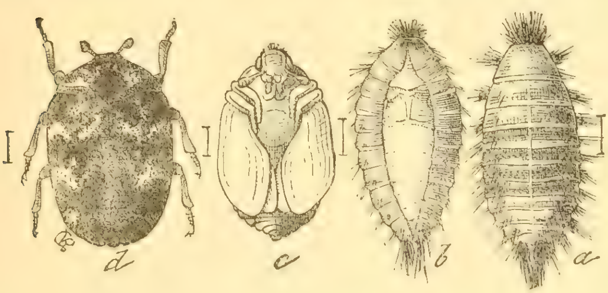

Fig. 18.

Fig. 18, *a* and *b*, larva ; *c*, pupa ; *d*, beetle.

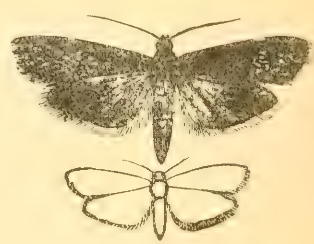

Fig. 19.

(a). Moth (imago) magnified.

(b). Outline, showing natural size.

new locality has been found at Valleyfield, Que. Specimens were sent to me from a mill early in October, and instructions were promptly given as to the best steps to take to clean the mill. These were adopted, and in December I received a report from the manager that the outbreak had been suppressed. I think it probable that he may have taken too favourable a view of the matter, and I have urged upon him the necessity of keeping a constant watch for any appearance of the insect. This is not only an extremely injurious pest, but an exceedingly difficult one to eradicate. I find that it occurs more or less plentifully in some of our large milling centres, and, where special efforts are not put forth to control it, loss is sustained.

THE GROWTH OF THE WINGS OF A LUNA MOTH.

By J. A. Moffat, London, Ont.

In the afternoon of March 5th, 1895, I heard a noise amongst my cocoons. On examination I found that it proceeded from the cocoon of an *Actias Luna*, Fig. 20, which had been given to me early in the season. It was extremely thin ; when I took it up I could see the movements of the imago through it. It was revolving as well as scratching

vigorously. It seemed to be conscious of its imprisonment, and appeared so eager to escape, it made me feel uncomfortable, so I opened a hole in the cocoon, out of which it crawled on to a finger which I extended for its convenience, thus missing an opportunity of seeing it dig its own way out. It was perfectly dry, and left no moisture on the cocoon or pupa case. I gave it a position to suspend from, where I could observe it conveniently. I looked at the time; it was a quarter to three. It did not show the slightest inclination to travel.

Fig. 20.

The abdomen was fully extended, green in colour with, comparatively, narrow white bands around it. The front winglets were about three-quarters of an inch in length, the hind ones less, clothed with hair-like scales, slightly tinged with yellow, sufficient to contrast with the pure white of the body covering. The tail was bent round and laid along the outer angle of the hind winglet, as shown by part *b* on Fig. 21, which gives a moderately correct representation of it on an enlarged scale. At five minutes to three a green spot appeared near the base of front winglet, gradually enlarging as the fluid spread between the membranes, and deepening in colour as the quantity increased. At three o'clock the green had reached the eye spot on the front wing, and the maroon colour of the costal band. At 3.10 the wing was one inch and a half long. By this time the fluid was passing rapidly along the costal edge and extending, whilst the outer angle had not yet begun to extend; the result was the apex drawn back, the membrane of the wing bulged and bagged outward. At this time the hind wing had got a green tinge along the outer margin, which was extending. At 3.20 the outer angle of front wing had relaxed somewhat, which allowed the costa to straighten and reduced the bulging. 3.35—the front wing looked to be full length, but not full width. 3.45—hind wing well expanded and green coloured; part *b* on Fig. 21 had moved away slightly from part *a*.

Fig. 21.

At four o'clock the space between a and b was nearly half an inch, but b yet retained its horizontal attitude. At 4.10 the space between them had increased, and the point of part b was drooping. 4.45—the tail had greatly extended, hanging crumpled and twisted. At 5.10 the moth opened its wings and walked away when I ceased taking observations. I allowed it to live over night. It was a female, not a first-class specimen. It measures four and a half inches in expanse of wing, and three and a quarter from the base of the antennæ to the end of the tail. It is heavily edged with maroon on the outer angle of front wing, and more lightly on the hind wing and outer curve of the tail. There is a row of brown dots on the veins of front wings, three-eighths of an inch from the coloured edge, which are not seen on any other native specimen in the collection. As it matured the abdomen contracted until the white bands united, and the green disappeared.

OBSERVATIONS ON THE SEASON OF 1895.

By J. Alston Moffat, London, Ont.

Hadena Arctica, Fig. 22, one of the climbing cut worms, the moth of which is seen to some extent every season, and in some seasons quite plentifully, appeared in the early part of June in extraordinary profusion, forcing itself on the attention of the most unobservant, and continued for over four weeks to be a complete nuisance to the community. It was to be seen everywhere; shop windows were rendered unsightly by their presence, dead and alive. They would enter dwellings, hiding away for the day in the folds of curtains and clothing, alarming the owners needlessly about their safety, and making themselves generally obnoxious in a hundred ways. I received inquiries concerning them from various directions, which went to prove conclusively that this state of things existed from the Niagara river on the east to the Detroit river on the west; and from the north shore of Lake Erie to the south shore of Lake Huron. How much further they extended I have not learned.


Fig. 22.

The Genus Argynnis, in some of its species, is to be seen more or less abundantly every season. But 1895 gave them forth in numbers both of species and specimens beyond all that I have ever seen before. During July there were five species on the wing at the same time. *Cybele*, *Aphrodite*, *Atlantis*, *Myrina*, and *Bellona*. Upon large patches of flowering weeds that were attractive to them they congregated in force, and when disturbed, they would rise in such a mass as to obscure the view beyond. It was my first experience with *Atlantis*. On the twenty-seventh of June I was in a locality where Argynnis was flying profusely. *Cybele* and *Aphrodite* were abundant, but there were some that seemed to be different from either, and with which I was not familiar. They were smaller in size and with a noticeable black border on the hind wings, so I captured some for comparison. All the *Atlantis* in the Society's collection are labelled "Montreal," and are quite uniform in size and markings. There were none of those I took that were quite so small, or with so much black in the border. On the first of July I secured more, and found that they varied considerably. Some of them I could not say whether they were small *Cybele* or large *Atlantis*, so to settle the doubt, I sent an example to Mr. W. H. Edwards, who promptly informed me that it was *Atlantis*. I saw them plentiful at Sarnia, and Mr. W. E. Macpherson, of Prescott, Ont., said it was the same at Windsor. On the sixth of August I received several specimens from Mr. Macpherson, taken by him at Prescott. They were much nearer to the Quebec type than the majority of those I took here; with a little additional black in the border of the hind wings, they might not be separable. I may state here as a matter of some interest that I never took at Hamilton what I consider to be typical *Aphrodite*, with the dark cinnamon-brown shade on the under surface of the hind wings, which is comparatively common about London, and easily obtained.

On the twelfth of August I had a call from Mr. Wm. Lochhead, of Napanee, Ont., on his way east from a visit to Windsor. When we were looking at a drawer of North American specimens that are labelled "Non-Canadian," his eye resting on *Argynnis Idalia*, he remarked : "There is a butterfly that was taken at Windsor." I had long desired to hear of that species being reported Canadian. I expected it to enter our territory in the east, but instead it has come to us in the west. Afterwards I received through the kindness of W. S. Cody, B.A., a Windsor specimen for the Society's native collection.

Fig. 23, Male.

Fig. 24, Female.

Pieris protodice has been seen here in greater numbers this season that it was last. It has also been reported to me from other localities. Mr. Macpherson, who spent some weeks collecting about Windsor, Ont., called upon me when he was returning east. Whilst looking over the Society's collection, when we came to the *Pieris* he pointed to the female of *Protodice*, remarking, "There is the butterfly I saw at Windsor and didn't know what it was!" An interesting testimony to its total absence of late years, which seems so strange to those to whom it was such a familiar object in times gone by. I received a letter from W. S. Cody, B.A., of Windsor, dated July 22nd, in which he said, "*Pieris protodice* appeared for the first time here about the 4th of July, although it might have been here unnoticed before that, and soon became more common than *P. rapæ*. Not being familiar with it, I took nothing but females for a while, and think they must have been more common than the males at first." We can easily understand how male *protodice* might pass unnoticed when flying with *rapæ*, Fig. 25. Mr. Anderson took males only here during July ; he did not even see a female. It has also been reported to me as being plentiful at Essex, Alvinston and Woodstock.

Fig. 25.

In 1895 the season for collecting commenced early, but received a check later on. Mr. Anderson reported to me some good finds at electric light before I thought it likely that anything could have been got, light proving more profitable with him than bait throughout the season. The fascinating power of light at night seems to be general over all kinds of insects, and by concentrating it at particular points makes it easy to secure quantities of them, and gives an opportunity of estimating the comparative scarcity or abundance of the various kinds better than any other method. In this way, Mr. Anderson could have taken dozens of some kinds that I thought I was doing well to get two or three of in a season in the ordinary way of collecting. Bait will not attract some, no matter how skilfully it is compounded, and it fails with all at times ; but light, especially electric light, never fails to draw, if the weather is at all propitious.

In September, I sent to Prof. J. B. Smith a box containing twenty-nine specimens of Mr. Anderson's securing, which I could not identify with anything in the Society's collection. Fourteen of these proved not to be represented therein. I had sent a few Bombycids which the Professor did not care to pronounce upon in the present transitionary

state of the nomenclature. There were some duplicates, different looking forms of one species, whilst others were varieties or better and more distinctly marked specimens of those already named in the collection. As a testimony to the character of Mr. Anderson's work, I quote from Prof. Smith's letter to me accompanying the list of names: "Your box of insects came duly to hand by express, and in good condition. It is by all odds the most interesting box you ever sent me, and contains the best species, as well as, I think, the best specimens I have ever had from you. * * * Your Nos. 2 and 5 (*Copipanolis cubilis*, Grote) are varieties of one thing, and, if you have others, I would very much like to have a specimen, since the species is not represented in my cabinet. No. 3 (*Feralia major*, Smith) is a very good species, recorded, I believe, for the first time from Canada in this sending. Your No. 11 (*Dicopis Grotei*, Morr,) is a beauty, and perhaps the handsomest specimen of the species that I have ever seen. No. 10 (*Xylomiges dolosa*, Grote) is by no means common. The other species need no special reference and are noticeable only by their excellent condition."

Amongst the Bombycids that I sent to Prof. Smith was a Gastropacha, which he gave as "*Ferruginea*, probably." This I expected would likely be so, as it corresponded well with the original description in everything except size. Packard says, Pro. Ent. Soc. Phil. Vol. III., p. 386, "A smaller species than *G. Americana*." But all the specimens that I have seen of this form are decidedly larger. In the "Preliminary Revision of the Bombyces of America North of Mexico," by Neumœgen and Dyar, *Ferruginea* is given as a variety of *Americana*. During the early part of May, *Americana* was abundant at light. This *Ferruginea* did not appear until the middle of June, and not so numerously, and the one had passed before the other appeared, which seems to conflict somewhat with the idea of their being forms of one species.

The other names of this lot that were new to the Society's collection are:

Acronycta hasta, Grote. Resembling *lobeliæ*, but smaller and darker.

Dicopis viridescens, Walk. A widely distributed species.

Mamestra detracta, Walk. The habitat of this species is given in Prof. Smith's List as Labrador, White Mountains, Colorado, 12,000 feet.

Xylophasia lateritia, Hubn. A European as well as American species.

Perigea luxa, Grote.

Scopelosoma devia, Grote. This addition completes the list of this genus in the collection.

Morrisonia evicta, Grote.

Hyblæa puera, Cram. Prof. Smith, in his catalogue, bibliographical and synonymical, gives the habitat of this species as Texas, Florida, West Indies; and remarks, "It seems to be a common form in more tropical regions and only occasional in our own fauna."

Melipotis jucunda, Hubn. This is but the second species of the genus to be represented in the Society's collection. *Limbolaris* was frequently taken about Hamilton. I am not aware of this species being reported from Canada before. The other species of this genus are all given as from the south and west.

I afterward sent a box of Bombycids to Mr. Harrison G. Dyar, who kindly determined them for me. Those of them that were new to the Society's collection of Mr. Anderson's captures are:

Lophodonta georgica, H. S.

Schizura leptinoides, Grote.

Ianassa lignicolor, Walk.

Cerura scolopendrina, Bdv. Upon this species Mr. Dyar remarks, "The specimen is of the form *Modesta*, Hud., the band broken as in *Albicoma*, Strecker." These names are varieties of *Scolopendrina*.

Mr. Anderson also secured two specimens of *Dilophonota ello*, Linn, in splendid condition; and a pair of *Protoparce cingulata*, Fab., with the pink ornamentation beautifully bright and fresh.

Fig. 26.

A rare and interesting capture by Mr. Anderson in the early part of October was a specimen of *Pyrgus tessellata*, Scudder, Fig. 26, fresh and in fine condition. It was in company with another, which he did not secure. This attractive butterfly has been reported once before from Ontario, taken by Mr. Lowe, in Essex County, and given under the synonym of *Hesperia oileus*, Humph.-West, June, 1875.

VARIATION, WITH SPECIAL REFERENCE TO INSECTS

By J. Alston Moffat, London, Ont.

"No compound of this earthly ball
Is like another, all in all."—Tennyson.

Variation amongst forms of life is one of the most interesting and evident truths in nature. The causes at work producing it are receiving a marked degree of attention at the present time, but not more than the importance of the subject deserves. No one has given thought and attention to its manifestation amongst living forms without being subjected to difficulty and perplexity by it. It lies right across the path of the investigator of the laws of life, and is the stumbling-block of the systematist. It cannot be ignored or thrown aside, but must be admitted, and a place given to it in every system in nature that is constructed.

The causes of variation in forms of life are many. Some of them are simple, apparent and easily comprehended. Others are obscure and difficult to trace. As a considerable diversity of opinion exists as to the source of its origin in nature, and the present state of our knowledge does not satisfactorily explain all that we see associated with it, therefore, an orderly statement in plain language of what is known on the subject may not prove objectionable to those who have got into perplexity and wish to investigate the subject for themselves.

All nature—that is, everything that comes within the range of physical investigation—is controlled by unchanging law. Each portion of it has a law or laws of its own, which we call the laws of its nature. We do not see these laws; we know of their existence only by observing the uniformity of their manifestations. For instance, given the same materials in the same proportions and in the same conditions, and the same results will follow every time. Change one of these by ever so little, and a different result will certainly be produced. Thus we have the ever-changing manifestations of nature from unchanging laws, through the ever-changing conditions and combinations of the same materials. Life is as completely under the control of law as matter, but it is infinitely more complex and difficult to trace.

Matter has been divided into the organic and inorganic. The inorganic surface of the globe is the foundation on which rest the organic forms thereof, and from which they may be said to have come, as all the materials for their solid structures and sustenance are derived therefrom. The face of this globe has been frequently changed. There was a time when life could not exist upon it. When the conditions became favorable, organisms appeared suitable for the conditions—low in the scale of life, but neither defective nor degraded. That forms of life varied with the varying conditions of the earth's surface, is conclusively demonstrated by the geological record, and that the organisms of the various geological periods were as thoroughly in harmony with the conditions in which they lived as are those of the present. That many of the forms of life in the present are the lineal descendants of some of those of previous geological periods is extremely probable, if not positively certain, but so changed in appearance by altered conditions as not to be now recognizable.

No doubt many forms of life came and went before insects appeared. These are comparatively highly organized forms of life, the higher appearing later in point of time, life keeping pace with its surroundings, and so maintaining harmony. The conditions are not uniform over all the earth's surface at the present time, and we know that the appearance of the life of the various portions of the globe differs in many instances to such an extent that an expert can tell from what part of the world a particular form came by its appearance; and thus we learn that variation in living forms is not a thing of recent origin.

Our knowledge of the extent to which variation may go is largely obtained from man's efforts to change for his own advantage those kinds which he thought were going to prove conducive to his welfare or gratifying to his fancy. But man's methods in bringing it about are not identical with nature's. Although they must be in harmony with the laws of nature for profitable results, yet illustrations taken from one and applied to the other may be very misleading.

Wallace, in his "Island Life," page 55, says: "Few persons consider how largely and universally all animals are varying. We know, however, that in every generation, if we could examine all the individuals of any common species, we should find considerable differences, not only in size and colour, but in the form and proportions of all the parts and organs of the body. In our domesticated animals we know this to be the case, and it is by means of the continual selection of such slight varieties to breed from that all our extremely different domestic breeds have been produced. Think of the difference in every limb and every bone and muscle, and probably in every part, internal and external, of the whole body between a greyhound and a bull-dog! Yet if we had the whole series of ancestors of these two breeds before us, we should probably find that in no one generation was there a greater difference than now occurs in the same breed, or sometimes even the same litter. It is often thought, however, that wild species do not vary sufficiently to bring about any such change as this in the same time; and though naturalists are well aware that this is a mistake, it is only recently that they are able to adduce positive proof of their opinions."

In this extract we get great truths clearly stated, with a misleading inference appended. No divergence has ever appeared in the dog family in nature at all comparable to that between a greyhound and a bull-dog, and I have no hesitation in saying never would, no matter what length of time was given, and so long as the dog remained in a state of nature, we might add never could, and the reason is simple and obvious. All man's domestic animals came originally from wild forms; all the possibilities that man has disclosed were latent therein. Under domestication they became apparent, then by selection, elimination and rejection, man led one strain in this direction and another in that, concentrating and exaggerating these points of difference until the present results have been reached. Now, selection in nature is of the most indiscriminate character possible. There is a constant commingling of the slightly divergent forms going on that never gives any peculiarity an opportunity to concentrate and disclose itself very conspicuously, and if it did in one instance it would be reduced or even obliterated, to all appearance, in the next generation. And it is this sort of selection that produces and maintains that marked degree of general uniformity which we see does prevail amongst living forms in a state of nature. Thus we learn how widely divergent is the result of selection in nature from selection by man for his own benefit, the one tending to reduce variation to a minimum, the other to carry it onward to its maximum.

The most powerful influence for the producing of variation in life in nature, is to be found in external conditions. A power inherent in a locality, capable of modifying the appearance of an organism residing therein, combined with the susceptibility in varying degrees of the organism to receive, retain and transmit the impressions. That living forms are changed in appearance by residence in different parts of the globe is a fact not requiring to be proved in the present day. It has forced itself upon the attention of all observing travellers, and the books of such travellers as Darwin and Wallace are full of examples of it; and as the attention of those engaged in the investigation of nature is

being more than ever turned in this direction, illustrations confirmatory of it are being multiplied. In his later writings, Darwin acknowledged that he might not have assigned to it all the importance that it deserves, or the consideration to which it is entitled, and as investigation progresses, its influence in producing variation in nature is becoming more generally admitted. In tropical countries, where life is under a kind of forcing process, this power is strikingly exemplified in insects. There we find variation showing itself in the changed appearance of the same kinds of insects, within shorter distances and in greater numbers. Wallace tells us of one form of butterfly that he traced from the seashore inland until it was scarcely recognizable as the same species, so greatly did it change. This is an exceptional case, but the influence is present, if only the organism is sensitive enough to take the impression. Then consider, that a similar influence is at work to some extent, in some direction, on every form of insect life in the world, and we may form some conception of the tremendous power at work producing variation; for it is a fact well established by observation of life in domestication, that when a change has been brought about in an organism, it is easier afterwards to produce more and greater. But more; the same laws that are in operation at present, producing such results, have been at work ever since insects had an existence. Through all the various geological periods in which they have lived, this moulding and modifying influence has been going on, so it is not very surprising that the liability to vary should be so well established in their constitution now.

Because such a power exists in nature, we have no authority for supposing that it may go on indefinitely, and produce not only different looking things of the same kinds, but also different kinds. That would be contrary to the laws of nature as we know them, also to observation and experience. Each sphere of influence is well defined, whether we can trace it or not. It has a centre where it will be most powerful, and a circumference where it may be more weak, but if a change is to be brought about in the organism, a change must be made in its habitat, or it must be made to change its habitat. What difference would be produced by the change would have to be discovered by observation, if the organism survived it, for it is well known that conditions not necessarily fatal to life in themselves, might become so if brought about suddenly. Organisms do not change themselves by an effort of the will; this influence is external to themselves, and modifies them quite unconsciously to themselves.

What these influences are, or how they operate in producing a change in organisms, is at present but little known. Past observations point to chemical agency as a powerful factor. Indeed, in one view of it, the surface of the sphere on which we live is one huge chemical laboratory. The process of disintegrating matter and re-compounding it is perpetually going on. Then the various organisms are composed of multitudes of cells that are endowed with the power of choosing and absorbing from inorganic substances the materials required for their own special wants, and passing them on to other cells to be transmuted into the proper ingredients for the producing and sustaining of every organ in each and all, even the most complicated and highly organized beings on the earth. In the case of insects, heat and cold, moisture or its absence, light and obscurity have been shown to have an influence in changing their size and colour, the result, no doubt, of chemical combinations and actions. We see frequent instances of the same conditions producing opposite effects in different organisms, attributable to the inherent power of cells for differently combining the same materials or transmuting them chemically. And now that the conclusion has at length been reached, confirmed by correct scientific investigation, and one which harmonizes so well with all our observations and experiences, that heat does not come to us through space, but is chemically produced within our atmosphere in some way by means of the sun's rays, which are electrical, we seem to have got in some measure an explanation of how geologic and climatic influences obtain their power to modify organisms.

Although external influences are the most powerful originating cause of variation in living forms in nature, the most obvious one, and the one that attracts the most attention, is brought about by the intermingling of existing varieties, which tends to produce yet more abundant variation. The parents being unlike, we see some of the offspring

taking after one parent, some after the other, some with a curious admixture of both ; whilst others have no special resemblance to either. One does not require to travel in order to obtain abundant evidence of this.

In following out this part of my subject, I shall have occasion frequently to use the term *species*, so it will be well first to define the sense in which I use it. I remark, then, that I accept without reservation Worcester's definition of the term, which he states thus :

"1. Appearance to the senses or the mind ; sensible or intellectual representation.

2. An assemblage of individuals allied by common characters, and subordinate to a genus or sub-genus ; a group.

☞ In zoology and botany *species* is founded on identity of form and structure, both external and internal. The principal characteristic of *species*, in animals and vegetables, is the power to produce beings like themselves, who are also productive."

Here we have the term as used in connection with non-living matter used in classification, and as specially applied to living matter. In non-living matter, such as soils, rocks and inorganic substances generally, *species* are separated by appearances as they present themselves to the eye or mind. They are tested by the senses, when found to be different, they are pronounced to be specifically distinct. There are no differences of opinion as to their right to be called *species* ; and the reason of it is, that they are inert and passive under external conditions. Specimens of the same species may be separated by thousands of miles, and that for thousands of years and no perceptible change has taken place in them. But living matter is constantly changing ; from less to greater ; from young to old ; from vigour to decay ; from one generation to another, all passing on to death and dissolution. What a gulf separates these two kinds of matter ! or, if you will, the same matter under such different conditions. Now it is not in harmony with what is considered to be exact scientific phraseology, to apply the same term in the same way to two such differently constituted subjects of investigation ; and separate *species* in living forms on exactly the same lines as in non-living matter. Taking "appearance to the senses" as the only guide to a definite conclusion ; and yet that is what has been, and is yet being done by numbers of systematists and the result is, confusion and uncertainty.

Take as an illustration of how this method works in practice, the oft quoted instance given in Darwin's "Origin of Species," p. 37. "Mr. Balington gives two hundred and fifty-one species to a given genus. Whereas Mr. Bentham gives only one hundred and twelve. A difference of one hundred and thirty-nine doubtful forms." Both are supposed to be competent authorities, why this vast difference in the result of an investigation of the same material ? The answer to the question is to be found in the method of conducting it. Mr. Balington probably had a keen eye for detecting things that differ. He surveyed his material and separated it according to appearances, and when he was done he found that he had two hundred and fifty-one forms in which perceptible differences presented themselves to his mind, and he called them *species*.

Mr. Bentham was probably more critical. He might take into account the fact that living forms were always liable to vary more or less, and he would see that some of these forms so imperceptibly merged into one another, that he suspected that they were not entitled to be called *species*, so he united some here, and some there along the line, making their differences more perceptible whilst he reduced their numbers to one hundred and twelve, according to his estimate of what constituted a *species*.

Now that is exactly what might happen with any two investigators of a genus, with numerous so-called species upon this continent, who separated their *species* by perceptible differences. And that is probably what did occur in the genus that originated the "Colias Controversy," or the one that has started the Argynnis contention. Darwin himself worked on the same lines, and he has told in his own vigorous language what trouble he got into through it. He says : "After describing a set of forms as "distinct species, tearing up my manuscript and making them one "species, tearing that up and making them separate, and then "making them one again—as has often occurred to me—I have "gnashed my teeth, cursed species, and asked what sin I had committed to be so

punished ?" and such is the natural result of an effort to attain to certainty, by means of an uncertain method; and no amount of investigation upon the same lines, by ever so competent an authority, can ever be unmistakably certain. The only conclusive verdict must be obtained by an appeal to nature; unite the differing forms, and if they have "the power to produce beings like themselves who are also productive," then the species is one, and the different forms are portions of it. This is the law of nature controlling all bi-sexual life, and it is extremely doubtful if there has ever been a well authenticated instance of its violation. Cases have been reported of so-called different species having been united, and the product carried forward for several generations, but that simply proves that the term *species* had been wrongly applied; and this wrong application of the term by namers and describers of species is traceable to the method of making species exclusively from perceptible differences. To illustrate the danger to which such are exposed in following that method, I quote the following passage from Wallace's Island Life" pp. 55 and 56. "An American naturalist, Mr. J. A. Allen, has made elaborate observations and measurements of the birds of the United States, and he finds a wonderful and altogether unsuspected amount of variation between individuals of the same species. They differ in the general tint, and in the markings and distribution of the colours; in size and proportions; in the length of the wings, tail, bill and feet; in the length of particular feathers, altering the shape of the wing or tail; in the length of the tarsi and of the separate toes; and in the length, width, thickness and curvature of the bill. These variations are very considerable, often reaching to one-sixth or one-seventh of the average dimensions and sometimes more."

We see in this extract, the perplexity that must necessarily arise in the mind of those engaged in studying such variable forms from their point of view, as to how far this sort of thing may go before it becomes a different species. Now, man has demonstrated most conclusively in connection with his domestic animals, that no amount of that kind of variation interferes in the slightest with the various forms uniting, "and producing beings like themselves, who are also productive." And the same laws are operating upon life in nature in the same way. *Species*, is a question of lineage; not of size, form or colours. These are incidental.

Having given the manner in which I use the term *species*, I continue the subject of variation.

We have seen that there are a combination of influences at work in every habitable portion of the globe, producing a change in the appearance of the life of each, in proportion to the susceptibility of the species to receive the impression. That such spheres of influence have a centre and a circumference, well defined although to us unperceived, except by the effect produced. Long residence in a locality for many generations giving the influence of that locality an opportunity to exert its utmost on the species living under it, whilst propagations with the local stock will tend to produce a more distinctive form of a species, acting as in-and-in breeding does in domestication. A fact well illustrated by the life of Islands, which is as a rule more uniform in appearance than that of continents with their extended areas.

Now it is an acknowledged fact that insects are notorious for spreading; either from their innate desire to migrate, or by external assistance. So the particular forms of one locality are constantly getting mixed with the different forms of the same species in another locality; uniting with them, "and producing beings like themselves who are also productive." It is a well-known experience of breeders in domestication, that when differing strains of the same species are united, a great uncertainty exists as to what the appearance of the offspring will be; and the greater the difference is, the uncertainty becomes proportionately greater. But more, we have to take into consideration not only the late ancestors which we may have seen, but remote ancestry which we could not see, that may have had in them strains that we never suspected, until they showed themselves in those we see.

Now this commingling of different forms of the same species is constantly going on all over the habitable globe, and given time and opportunity a species, or its descendants, could encircle the earth and produce confusion amongst the typical forms of every locality.

And when we consider that the forms of each locality are thus pushing their way outward, to mingle with those of other localities, we have an abundant source of supply for unlimited variations from the well marked and easily defined forms of any species, to the most minute shades of differences that are well calculated to drive the makers of "Species by perceptible differences" to the verge of distraction.

Let us now throw the reins to imagination, and urge it on to its utmost capacity, for it can never exceed the truth in this direction, and conceive if you can the multiplied diversity of external influences that insects have been subjected to since they were first originated up to the present time. Think of the differences of the environments they may have lived in for a greater or less extended period, and that each and all were perfectly adapted to their times and conditions, harmonizing with and fitting into them as naturally and unconsciously as water fits into a vessel. That the surface of the globe has always been diversified in climate; that insects were as susceptible to external influences, as much given to migrating and mingling together the diverse forms of the same species, and thus multiplying diversity as now; and that this and a great deal more has gone on through all the geological eras and ages that have intervened between their first appearance and the present, there seems but little cause left for wonder that *species* should be difficult to define by perceptible differences. But lest the surprise should take the opposite direction, and the wonder be that classification is possible, remember that this has all gone on under the control of unchanging laws—the laws of life and heredity, with their marvellous power of colour and form, producing beauty and attractiveness; the laws of matter and force, those that make for change and those that tend to stability; chemical affinities and combinations; brought about through light, cold, heat, and electricity; change without haste, yet without cessation; almost imperceptible, but unmistakably accomplishing results; like some huge, complicated, perfectly adjusted, self regulating machine, so absolutely perfect in its operations that it has never needed alteration or repair since it was first set in motion. Or as the fabled mills of the gods that ground very slowly but very fine, whilst the outcome of the process is what we see. Here we have "descent with modification" throughout the ages, but the same species still, if in the direct line of descent.

In such plain and evident facts of nature we seem to get sufficiently powerful and persistent causes to bring about the superabundant diversity that characterizes insect life without entering upon those that are obscure and doubtful.

The period of existence when insects are most susceptible to external influences are in the egg, larval and pupal stages. It is in these that the impressions are received which afterwards show themselves in the changed appearance of the imago. When a change has been produced in the appearance of the mature insect, a change may reasonably be expected in its early stages. Therefore when different localities are possessed of influences that are capable of making themselves manifest in the different appearance of their mature forms, and the early stages of these forms partake of a corresponding difference, and they breed true to their particular forms through all their stages, it proves nothing whatever as to their specific standing. This for conclusive settlement will require the extremes of the mature forms to be brought together, united, and see if they will produce beings like themselves, who are also productive. If so, then the species is one, regardless of their differences.

My subject would seem naturally to end here, but there are views held by some that are not in harmony with those stated, which will suggest objections that can be anticipated and may be replied to here without departing from its general scope and purpose.

Some will be ready to say, if the species is one the name should be one also. I reply, that a single description can never cover a multiform species. A constantly recurring form that requires a separate description to make it recognizable, should have a separate name. This might have the effect of reducing the number of species and increasing the number of names. Mr. W. H. Edwards has somewhere said (I quote from memory and may not be exact): "We have no such a butterfly as *Ajax*. We have *Walshii*, *Abbotii*, *Telamonides* and *Marcellus*. These four forms constitute *Ajax*." Here it requires four descriptions and four names to correctly distinguish one species. Mr. Edwards applies

that principle throughout his check list to all seasonally polymorphic butterflies. Let the same principle be followed in dealing with all sorts of variations, amongst all kinds of insects, and worked out in their classification, so far as is known, and what an amount of exact information could be conveyed at a glance as to the relationship of the different parts of any multiform species. We would have the different forms that are to be found in separated localities in the same country distinguished by name, and the forms of the same species found in other countries, continents or islands, with distinguishing names, whilst their habitat might be indicated as well. We should have also the kind of varieties, whether permanent local forms or incidental variations on these, brought about by the intermingling of separate forms, varieties wholly the result of natural operations, or produced by man's interference with the course of nature in pursuit of his own ends, and thus including the most recent variations; giving an opportunity to indicate forms that may have been exterminated through altered conditions, varieties seasonal, sexual or unaccountable, thus giving a world-wide view of every variable species according to the extent of knowledge procurable up to date, laying a solid and certain foundation for future advances in the same direction. It would be an immense convenience if *species* could be defined by appearance with certainty, but past experience has, so far, proved it hopeless. An approximation to the facts is the most that can be looked for. Ova, larvæ, and pupæ can all be classified by appearances as well as imagoes, but a system reared upon preparatory stages would fail of certainty as sure as on the mature one. No regularly graduated line can be formed of either, some inconvenient breaks are found in all. Some forms are found that will not fit in comfortably anywhere, whilst affinities are found in others that point in opposite directions. Yet for final arrangement and classification surely it is upon the affinities and resemblances of the mature form it ought to be founded, all the others being but preparatory thereto. So I conclude that the limit of *species* is found by uniting two, when the beings produced are uniformly non-productive, but the limit of variation cannot be reached until the power to produce different conditions and combinations has been exhausted.

SOME WINTER INSECTS FROM SWAMP MOSS.

By W. Hague Harrington, F.R.S.C., Ottawa.

Where are the insects in winter? What becomes of all the varied winged and painted forms that in the hot summer hours fill the air with movement and sound? Then every nook and corner of the land has its tiny familiar folk, flitting from flower to flower, in restless haste; every plant has its devouring hosts, and crawling, running, leaping creatures swarm in every direction. With the shortening days and the approach of frost, the myriads of insects, which have added so much to the joyous, exuberant life of summer, fast disappear and silence broods through forest glades and over meadow vales, which rang continuously with the shrill murmurings and stridulations of the innumerable orchestra. A few drowsy flies crawling on a sunny surface, or an occasional butterfly flitting in the midday warmth, may occur until winter has well set in, but these at last disappear. The winds strip off the dead foliage, the frost congeals the surface of the ground, and snow covers, beneath its chill pure shroud, a land from which all life seems to have departed. "All the insects are dead" the thoughtless remark, forgetting for the moment that they will be as numerous and lively in the forthcoming summer, and that none of the immense variety of forms will be created afresh.

Certainly the vast majority of the individuals, which are seen during the warmer season, perish before the close of the season, for the life of most insects is but a brief span, but the perpetuity of the species is preserved in spite of the apparent death of all the individuals. In some secure hiding places, then, the representatives of each species must remain during the long months of frost and snow. Those who have not made a study of our smaller forms of life would find it difficult to search out any of the swarms which are waiting for the vivifying breath of spring. Some might remember that our houseflies have crawled away into cracks and crevices, from which to sluggishly emerge

when it becomes warmer, but probably this would be the measure of their knowledge of the winter life of our insects. The entomologist, (concise term for the student of insect life,) however, who seeks to make himself acquainted with the complete life-history of each species, has as an essential part of his task to discover how the winter is passed. Naturally he finds that there is much diversity of habit, and that it may be either as egg, larva, pupa or imago, (adult or fully developed form) that the long cold months are safely tided over and the unbroken succession of the species preserved.

Many of our forms find security in the bottoms of the streams and pools, protected by the shield of ice which has been formed above them. Others are safely buried in the ground, beyond the reach of frost, or hidden in their burrows in our forest trees, but a great proportion are incapable of attaining such a degree of protection, and have to be content to hide in some crevice or similar shelter, or to depend upon such covering as they may be able to construct. It might well be supposed that those non-aquatic insects which hibernate in the perfect state would seek out some nice dry cranny in which, if possible, to shelter themselves from both cold and wet. Surprise may therefore reasonably be excited when it is discovered that a considerable degree of moisture seems in no degree harmful even to many species of a most delicate and fragile organization. The saturated frozen mosses of the swamps might appear the very opposite of suitable winter-quarters, and yet they very frequently contain an amazing number and variety of insects.

Having at several times gathered quantities of such mosses in the early winter, and obtained from them many interesting specimens, it has occurred to me that a brief summary of the result of my last foray of this sort might be of some interest to those who are curious as to the winter existence of our insects. I hope, too, that the list which I shall furnish may be of some little value to our many students in this branch of natural history, and may perhaps give some new light as to the habits of some of the species. For in all of our investigations we must bear in mind that, without a complete knowledge of the full yearly round of the existence of each species, we may perhaps lack just what it is most essential to know.

At the present time great attention is given to what is called economic entomology, which merely means the application to the benefit of the community at large of the knowledge which is slowly and laboriously gathered by many students, working generally merely for their own love of investigation, and often at considerable expense and self-sacrifice. At the Central Experimental Farm, at Ottawa, Canada has employed a very capable and indefatigable entomologist whose investigations and reports cannot but convey much needed information to the agricultural population. But the capacity of any man to make investigations is limited by the time at his command, and he is therefore compelled to avail himself of the labours of others, and as there is no one, especially if resident in the country and engaged in agricultural pursuits, who has not opportunity for observing the habits of some of our insects, there should be many who could render some aid to our excellent Government Entomologist, Mr. Fletcher, by communicating to him the observations that have been made. In devising methods for the destroyal and control of those insects which are classed as injurious (either to plant or animal life) it may become important to ascertain how they survive the winter, so as to know at what season they may be most easily and cheaply combatted.

Before proceeding with my list of species I will summarize for my non-entomological readers the method employed in collecting the specimens. The best localities for gathering the moss are to be found in swamps, surrounded and interspersed with trees and shrubs, and offering to the botanist in summer a considerable variety of plants. The ordinary sphagnum moss which may be found in some places is too wet to contain many insects, but the mosses which occur in abundance in somewhat drier localities will generally well repay investigation. It is profitable also to collect those which grow around the roots of trees, upon fallen logs, and upon the little knolls and hummocks of the swamps. The mosses, of course, will be mixed, more or less, with grasses, fallen twigs and leaves and various foreign matters, but the presence of these is not a source of any inconvenience in examining the material collected. A sackful gathered in the nearest swamp will furnish interesting occupation for many subsequent hours, and its contents

can be examined as opportunity offers. A damp, cool cellar is the best place to keep it until such opportunities occur. For the examination of the moss, take a shallow box, several inches square and about three deep, and replace the bottom by fine wire netting of about eight holes to the linear inch. Placing this box upon a sheet of white paper, a handful of moss is torn to pieces in it, and the insects which may be present will fall through the netting. Before emptying the debris out of the box give the latter a sharp tap to dislodge any that may be "playing possum" or clinging to the wire. The insects which are now seen scampering off at different rates of speed may be picked up with a fine forceps or the moistened tip of a camel's hair pencil, and dropped in a small phial of alcohol or a cyanide bottle. It is well, if possible, to do this work in an uncarpeted room, or one in which a few spiders and other forms which will surely escape, may not create any disturbance. Spiders especially display great alacrity in making themselves scarce, and there are many beetles that are most agile in their movements, and even if picked up in the forceps will wriggle out and dart off in a new direction, always aiming, however, for the farthest edge of the table.

By adding the species collected in previous years my lists could be lengthened but I intend to confine them to the results obtained from the gathering of one season. The material examined consisted of about a peck collected on 17th Nov., about the margins of a little swampy inlet below the aboretum of the Experimental Farm, and the contents of an ordinary grain-sack filled, six days later, in Dow's swamp, (a regular cedar and tamarac marsh) upon the opposite side of the canal. At the latter date the surface of the ground was frozen and some snow had fallen, so that the moss was partially frozen and mixed with snow, making the bag pretty heavy for portaging, and I remember that, when I boarded an electric car with my burden, it provoked general curiosity (which remained unsatisfied) on the part of my fellow passengers. I have separate records of the insects from each place, but as the dates and localities were so near together I shall give but one list of the coleoptera, hemiptera and hymenoptera with the joint number of individuals of each species, to show their relative abundance.

The total number of species enumerated is 147; of which 52 occurred in both localities, 59 in Dow's swamp only and 36 at the Experimental Farm only. The number of individuals mounted and examined was 1,345, of which 889 were from the swamp and 456 from the Farm. These figures do not represent all the insects yielded by the moss, for of several of the commoner species no attempt was made to save all the examples, while some individuals escaped in spite of all attempts to capture them. In addition there were numerous individuals belonging to some of the other orders of insects, such as flies, thrips, and spring-tails, of which there were several varieties always leaping around. There were also many allied forms, such as mites, spiders, chelifers and myriapods. Among the many larvæ of various kinds may be noticed especially one which was not infrequent, and which afforded apparently a striking instance of protective mimicry. This was the larva of some fly, in which the segments of the body were so shaped and ornamented as to give the creature, which was of a bright green colour, an exact resemblance to a fragment of the moss.

The several varieties of moss contained in this gathering formed in themselves an interesting subject for examination, and in addition to the various forms of life already noted there were many examples of several of our smaller molluscs. Of these there were probably more than a dozen species, and they were preserved and handed over to one of my conchological friends to add to his collections and records. The examination of the moss was not concluded for several weeks, and it was found that its occupants remained alive and active so long as it was not allowed to become too dry, or was not exposed to excessive cold. Many of the insects proved most interesting and several had not previously been found by me. I regret that about one-third of the species have not yet been satisfactorily named, which indicates that the knowledge of our insects is yet very imperfect, and that more students are needed in the entomological field.

COLEOPTERA.

CARABIDÆ.

Bembidium variegatum *Say*	2
sulcatum *Lec*	6
Pterostichus femoralis *Kirby*	12
Platynus picipennis *Kirby*	2
Lachnocrepis parallelus *Say*	1
Oodes fluvialis *Lec*	1
Tachycellus nigrinus *Dej*	3

DYTISCIDÆ.

Ilybius ignarus *Lec* ?	1
Ilybiosoma bifarius *Kirby*	1
Agabus sp.	1

HYDROPHILIDÆ.

Hydrochus subcupreus *Rand*	3
Hydræna pennsylvanica *Kies*	6
Philhydrus perplexus *Lec*	2
sp	2
Hydrocombus lacustris *Lec*	8
Hydrobius feminalis *Lec*	8
fuscipes *Linn*	1
subcupreus *Say*	6
Cercyon sp	2
Cryptopleurum vagans *Lec*	14

SILPHIDÆ.

Colon sp	4
sp	1
Clambus puberulus *Lec*	1

SCYDMÆNIDÆ.

Scydmænus fossiger *Lec*	40
sp. (small)	27

PSELAPHIDÆ.

Ctenistes piceus *Lec*	6
Pselaphus erichsonii *Lec*	15
Tychus longipalpus *Lec*	1
Decarthron abnorme *Lec*	3
Ratrisus globosus *Lec*	1
Bryaxis conjuncta *Lec*	68
rubicunda *Aubé*	9
propinqua *Lec*	128
Trimium sp	1

STAPHYLINIDÆ.

Falagria bilobata *Say*	6
dissecta *Er.* ?	1
Aleochara nitida *Grav*	4
sp	1
? sp	1
Dinopsis americanus *Kraatz*	1
Acylophorus pratensis *Lec*	2
Philonthus lomatus *Erich*	4
nigritulus *Grav*	7
decipiens *Horn*	2
Diochus schaumii *Kraatz*	16
Stenus femoratus *Say* ?	28
erythropus *Melsh*	2
pusio *Casey*	4
caniculatus *Gyll*	9
croceatus *Casey*	2
Euæsthetus americanus *Er*	3
Lathrobium punctulatum *Lec*	1
bicolor *Lec*	1
concolor *Lec*	2
simplex *Lec*	2
sp	1
Stilicus dentatus *Say*	6
Lithocharis sp	8
Sunius binotatus *Say*	1
brevipennis *Aust*	2
Tachyporus jocosus *Say*	1

STAPHYLINIDÆ—*Continued.*

Tachyporus brunneus *Fab*	12
Conosoma sp.	2
Boletobius sp	1
Mycetoporus americanus *Er*	5
Olisthærus substriatus *Gyll*	1
? sp.	1
? sp.	44
? sp.	14
? sp.	5

TRICHOPTERYGIDÆ.

Trichopteryx sp	116
sp	6

SCAPHIDIIDÆ.

Scaphisoma convexum *Say* ?	2

CORYLOPHIDÆ.

Artholips marginicollis *Lec*	23

COCCINELLIDÆ.

Hippodamia 13-punctata *Linn*	1

CUCUJIDÆ.

Læmophlæus convexulus *Lec*	1

CRYPTOPHAGIDÆ.

Atomaria ephippiata *Zimm*	45
sp. (brown)	38
sp. (black)	1
sp. (small red)	24
? sp	3

NITIDULIDÆ.

Omosita colon *Linn*	2
Ips fasciatus *Oliv*	4

LATRIDIIDÆ.

Stephostethus liratus *Lec*	1
Corticaria pumila *Lec*	53
cavicollis *Mann*	3

BYRRHIDÆ.

Cytilus sericeus *Fab*	2

DASCYLLIDÆ.

Cyphon variabilis *Thunb*	3

THROSCIDÆ.

Throscus alienus *Bonv*	1

BUPRESTIDÆ.

Taphrocerus gracilis *Say*	1

CHRYSOMELIDÆ.

Donacia Kirbyi *Lac*	1
Chætocnema subcylindrica *Lec*	5
Odontota nervosa *Pang*	2

OTIORHYNCHIDÆ.

Otiorhynchus ovatus *Linn*	2

CURCULIONIDÆ.

Apion sp	1
Phytonomus nigrirostris *Fab*	35
Listronotus sp	1
Macrops sp	3
Tanysphyrus lemnæ *Fab*	1
Acalyptus carpini *Hbst*	1
Pelenomus squamosus *Lec*	2
Cœliodes nebulosus *Lec*	1
? sp.	2

Notes on the Coleoptera.

Two-thirds of all the species belonged to the Coleoptera, or insects in which the hind pair of wings, when present, are the organs of flight, and are protected by the thickened front pair, known as elytra. A large proportion of our beetles are ground-dwellers, roving about through the herbage and moss, or hiding under stones and rubbish, and these are best represented. Many of these are predaceous; the remainder feeding chiefly upon decaying animal or vegetable matter, and comparatively few attacking living plants. In the above list twenty-two families are represented by 103 species, of which forty occurred in both gatherings, while twenty-seven were peculiar to the Farm and thirty-six to the swamp. The former locality furnished 383 individuals and the latter 594, so that, with the beetles that escaped or were not preserved, there were considerably over 1,000 examples in these mosses, which certainly shows that they were pretty thickly distributed throughout the swamps.

Of the seven species of Carabidæ, *Oodes fluvialis* was a new record for Ottawa, while *Lachnocrepis parallelus* is also an uncommon species here These beetles were found under the thick covering of a prostrate log, and were in shallow cells in the earthy matter on which the moss grew, evidently prepared to abide the winter there, as is done by other members of this family. The Dytiscidæ and Hydrophilidæ are aquatic or subaquatic beetles, although many of the smaller species live largely in decaying vegetable matter. The Pselaphidæ, a family well represented both in species and individuals, contains very small forms, which are stated to feed upon animal substances, and probably subsist in part upon other small inhabitants of the moss. *Bryaxis propinqua* and *B. conjuncta* are remarkably abundant, especially in Dow's swamp. Nearly one-third of all the species of Coleoptera belong to the Staphylinidæ, a very extensive family which I have not found time properly to study and of which there are many unnamed species in my cabinets, even of the commoner forms. These beetles are slender, depressed, elongated insects, with short elytra, remarkably quick and erratic in their movements, and living chiefly on decomposing animal or vegetable matter. The genus Aleochara contains, however, true parasitic species.

Of all our beetles the smallest species are those that belong to the family with the very long name, Trichopterygidæ, which signifies that they have wings fringed with hairs. One species was present in great numbers, and although mere black specks on the white paper the beetles are very nimble and run swiftly about. The members of the Cryptophagidæ and Lathridiidæ are also very small, and subsist upon fungi and decaying vegetation. One of the most interesting beetles of the list is the pretty little *Taphrocerus gracilis*, the only buprestid I have ever found hibernating. This species is taken with the sweeping net in low meadows in June and I believe the larva feeds in the stems of the sedges or large grasses. All the rest of the beetles are plant feeding, and the most abundant species, *Phytonomus nigrirostris*, is known as a clover-pest.

Hemiptera.

Corimalæna pulicaria *Germ*	5	Coriscus inscriptus *Kirby*	1
Neotiglossa undata *Say*	1	Salda sp. undescribed	1
Cymus angustatus *Stal*	5	Ulopa canadensis *VanDuzee*	62
Salicia pilosula *Stal*	3	Acocephalus mixtus *Say* ?	6*
Scolopostethus affinis *Schill*	2	Helochara communis *Fitch*	4*
Lygus flavonotatus *Prov*	2	Philaenus sp.	1
Corythuca arquata *Say*	7	Livia vernalis *Fitch*	1
? sp.	17*		

Notes on the Hemiptera.

The species of Hemiptera include ten belonging to the division Heteroptera and five to the Homoptera. They were more abundant in the drier mosses. Seven species were common to both localities and four peculiar to each. The total number of individuals was 118, of which more than half belonged to the curious short-winged species which Mr.

VanDuzee has named *Ulopa canadensis* and which has been noted previously as occurring in Ottawa. Mr. Kilman has also found the species at Ridgeway, and it is probably widely distributed. The specimens marked with an asterisk were nymphs, or immature forms, so that the species could not be exactly determined. The insects belonging to this order are the only forms properly entitled to the name "bug," and they are mainly plant-feeding. Subsisting upon the juices, which they suck from the leaves and stems by means of the tubular beak formed by the prolongation of the mouth-parts, they rank among the insects most injurious to plant life, and are most difficult to destroy or keep in check. The smaller forms, known as plant-lice, are very numerous in species, and they multiply with great rapidity, so that a very brief time suffices for the attacked plant to become quite covered by the immense number in all stages of growth, and to have its vitality exhausted.

HYMENOPTERA.

PROCTOTRYPIDÆ.	
Megaspilus ottawaensis *Ashm*	5
Ceraphron minutus *Ashm*	4
flaviscapus *Ashm*	2
carinatus *Ashm.* ?	5
mellipes *Ashm.* ?	2
Aphanogmus bicolor *Ashm.*	8
Telenomus sp	1
Acoloides subapterus *Ashm.*	4
seminiger *Ashm*	1
sp. nov. ?	1
Bæus minutus *Ashm*	47
Prosacantha melanopus *Ashm*	1
Hoplogryon brachypterus *Ashm*	41
sp. nov. ?	1
Gryon canadensis *Ashm*	68
borealis *Ashm*	3
Paramesius clavipes *Ashm*	2
Diapria sp	1
Trichopria carolinensis *Ashm*	4
PROCTOTRYPIDÆ.—*Continued.*	
Trichopria sp. (apterous)	2
sp	1
Phænopria aptera *Ashm*	16
hæmatobiæ *Ashm*	10
MYMARIDÆ.	
Cosmocoma sp	2
FORMICIDÆ.	
Camponotus marginatus *Latr*	1
Lasius brunneus *Latr*	1
Tapinoma erraticum *Nyl*	1
MYRMICIDÆ.	
Myrmica lobicornis *Nyl*	14
sp	1

NOTES ON THE HYMENOPTERA.

That this order should be so well represented will probably be a matter of much more surprise than the occurrence of a large number of the ground-frequenting beetles. One is apt to think of its members, in their adult form at least, as delicate-winged forms flitting about in the sunshine. But besides the ants there are many wingless or sub-wingless forms belonging to the various parasitic groups. Nearly half of the species in the above list belong to these non-flying hymenoptera, but the remainder have fully developed wings. It will be seen that twenty-nine species are enumerated, of which five occurred in both localities, five at the Farm only (of which four were ants) and nineteen only in the swamp, which was decidedly the most prolific ground, yielding 218 out of the 250 specimens collected. Many more ants could have been collected, for their nests, some of considerable size, were scattered all through the swamp, but those secured were stragglers that had probably got lost in their wanderings, and had not been able to reach home before the cold weather stopped their journeyings. With the exception of these ants all the species are very minute, and belong to the family Proctotrypidæ; except one species belonging to the Mymaridæ, a small group formerly included in the Proctotrypidæ but which Mr. Ashmead considers should constitute a separate family. The first six species belong to the sub family Ceraphroninæ, whose members are parasitic on Aphididæ (plant lice) and Cecidomyiidæ (midge-like flies forming gall-like swellings, etc.). The following ten species belong to the sub-family Scelioninæ, all of which are egg parasites, the larvæ living in the eggs of other insects. I have bred as many as thirty-one individuals of a species of Telenomus from two eggs of one of our large moths, but usually one parasite occupies each egg. Seven species belong to the sub-family Diapriinæ, parasites of the larvæ of flies. The most abund

ant form was the wingless *Gryon canadensis*, of which all but five specimens were from Dow's swamp. The closely allied, short-winged *Hoplogryon brachypterus* was almost as numerous, three of the specimens being from the Farm. The second in point of numbers was *Bæus minutus*, which occurred only in the mosses from Dow's swamp. Probably some individuals escaped my notice when I was sifting the moss, as it is much the smallest species in the list. It is a very agile atom, and able to leap a considerable distance, while even the least dust upon the paper suffices to hide it, as it is a mere speck itself The whole forty-seven specimens placed head to tail would make a line hardly an inch in length. As the members of this genus are parasitic in the eggs of spiders this minute species will probably infest the eggs of some of our smaller spiders, but I have not yet succeeded in breeding any. The Cosmocoma is a fragile little form with narrow wings, interesting chiefly as being the first mymarid which has been captured by me, and probably the first recorded from Canada. In conclusion, it is hoped that these imperfect lists and notes thereon may stimulate further observations on the winter habits of Canadian insects.

BIRDS AS PROTECTORS OF ORCHARDS.*

By E. H. Forbush, Ornithologist of the Massachusetts Board of Agriculture.

Having had, during the last twenty years, some opportunity for observing the food habits of birds, I have become convinced that they destroy enormous numbers of insects. This conviction gives rise to the question, to what extent are birds useful to man in this respect?

The present paper is merely a partial record of the results of an attempt to foster and protect birds in an old and neglected orchard with a view to observing the effect of such a policy upon the trees. The orchard is so situated as to be a favorite haunt for birds. It forms part of an estate in Medford, Mass., lying near the southern border of the stretch of wooded rocky hills known as the "Middlesex Fells," a large part of which is now under the control of the Metropolitan Park Commission of Massachusetts, and is being administered as a forest reservation. The nearest estates on the east and west of the orchard are cultivated to some extent. There are other orchards in the immediate vicinity, and many fine and large shade trees. There are also on the estate in question many varieties of trees and shrubs. There is a small piece of woodland, covering perhaps an acre and a half, in which yellow pine predominates, the other trees being principally ash, oak and maple, some hickory and a few white pines. A lane running along the southern border of the estate is bordered on both sides with elms and poplars. A line of mulberry trees along the lane south of the orchard affords tempting food for such birds as are fond of fruit in its season. There are also many wild cherries and berries of several varieties, together with half a dozen trees of cultivated cherries.

Among the trees, shrubs and vines found on the estate and which furnish food for birds in the shape of berries or seeds at certain seasons of the year are the *Berberis vulgaris* (common barberry), *Vitis labrusca* (northern fox grape), *Rhus toxicodendron* (poison ivy), *Prunus Americana* (wild yellow plum), *Prunus Pennsylvanica* (wild red cherry), *Prunus Virginiana* (choke-cherry), *Prunus avium* (English cherry), *Rubus occidentalis* (black raspberry), *Rubus villosus* (high blackberry), *Rubus idæus* (garden raspberry), *Rosa nitida* (wild rose), *Pyrus malus* (common apple), *Ribes rubrum* (common red currant), *Fraxinus Americana* (white ash), *Morus rubra* (red mulberry), *Quercus alba* (white oak), *Quercus coccinea* (scarlet oak), *Pinus strobus* (white pine), *Pinus rigida* (pitch pine), *Thuja Canadensis* (hemlock), *Juniperus Virginiana* (red cedar).

The orchard itself is a typical old orchard, such as is often found on small farms. It has suffered greatly from neglect. Two-thirds of the original trees have died or are in the last stages of dissolution. This is largely the result of neglect and improper pruning. Dead limbs and hollows in the trees have offered nesting places for such birds as the wren, woodpecker and bluebird.

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For three years, from 1891 to 1893, inclusive, the trees were trimmed and cared for. They were sprayed or banded to protect them from canker worms, and the "nests" of the tent caterpillar (*Clisiocampa Americana*) (Fig. 27), were removed. The result was a scanty yield of apples from most of the trees. One or two bore quite plentifully.

In order to observe the effect of the feeding of birds in the orchard, no care was taken in 1894 to protect the trees. During that year the tent caterpillars were very numerous in the vicinity, and it became evident also that a great increase in the the number of canker-worms was taking place in the neighborhood. Although these insects made considerable inroads upon the trees, they did not seriously injure the foliage anywhere except in one or two instances. No attempt was made previous to 1895 to foster or encourage the birds in the neighborhood, except that a few nesting boxes were put up in 1894, which were occupied in one case by a family of wrens, and in another by the English or house sparrow. We were careful, however, to destroy the nests of the house sparrow.

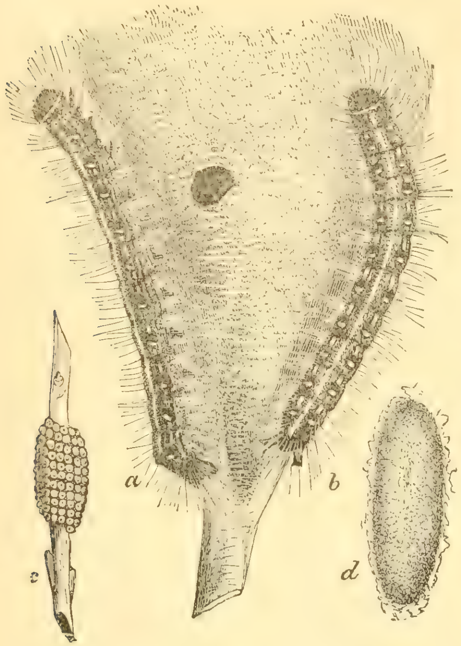

Fig. 27.

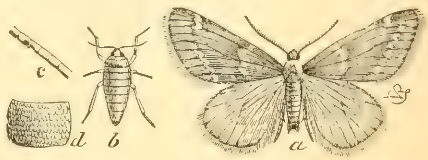

Fig. 28.

In the fall of 1894 it was noticed that immense numbers of the wingless females of the fall canker-worm (*Anisopteryx pometaria*) (Fig. 28, *b*), were ascending nearly all the trees and depositing their eggs; also, that the eggs of the tent caterpillar moths were numerous upon the twigs promising a plentiful supply for 1895.

Having allowed the insects one year to increase unmolested by man, we began in the winter of 1894 95 to encourage the presence of birds in the orchard.

In 1894 a small tree in the centre of the orchard had been enclosed by a high board fence. The tree thus enclosed was used as an outdoor experiment station for observation on the breeding and habits of the gypsy moth. During the winter 1894-95, Mr. C. E. Bailey made frequent visits to this tree to ascertain whether or not the birds were destroying the eggs of the gypsy moth. Incidentally, Mr. Bailey observed many interesting things in connection with the feeding of the birds on the eggs, larvæ and pupæ of insects which wintered on the trees, and I am greatly indebted to him for many interesting notes on the feeding of birds in this orchard. He is a careful, conscientious observer, and is intimately acquainted with most of our native land birds.

Hunters and trappers are aware that many species of winter birds, such as titmice, woodpeckers, crows, jays and nuthatches are attracted by a skinned carcase suspended from a limb, and will remain in the vicinity until all the bones are picked clean or until, with the approach of spring, insect food becomes more accessible.

Believing from my own observations that the chickadees (*Parus atricapillus*) were feeding on the eggs of the fall canker-worm, I asked Mr. Bailey to attract the birds, if possible, to the orchard by suspending pieces of meat, bone, suet, etc., from the trees.

These food materials are suitable for birds at times when the trees are covered with snow or ice and when, lacking such nourishment, they might starve. Although birds will frequently visit bait provided for them and in time will eat a considerable portion of the meat, they do not depend entirely on this aliment, but spend the greater portion of their time in searching for insects and eggs in the immediate vicinity.

Finding a plentiful supply of food, the chickadees remained about the orchard most of the winter, except for a week or two, when the meat gave out, but they were lured back again later by a fresh supply which was placed in the trees. Not only were the chickadees attracted to the orchard in large numbers, but other birds came also. A pair of downy woodpeckers (*Dryobates pubescens*) and two pairs of nuthatches (*Sitta carolinesis*) were frequent visitors, and a few brown creepers (*Certhia Americana*) came occasionally. All these paid frequent visits to the meat and suet, and also thoroughly inspected the trees in search of insect food. They made excursions also to the trees in the neighborhood, but the greater portion of their attention was confined to the orchard in which the bait was suspended. As they became more accustomed to Mr. Bailey's presence they grew quite tame, and could be viewed at a distance of a few feet. Indeed, chickadees frequently alighted on his person and occasionally took food from his hand. He was thus enabled to determine accurately (without killing them) what they were feeding upon, and was soon convinced that they were destroying the eggs of the canker-worm moth in large numbers, as well as the hibernating larvæ and pupæ of other insects injurious to trees.

To determine how many eggs a single chickadee would eat, a few birds were killed and their stomach contents examined, with surprising results. There was no difficulty in identifying the eggs of the canker-worm moth which were found in the birds' stomachs, as a great portion of the shells remained intact. The other insect contents of the stomachs

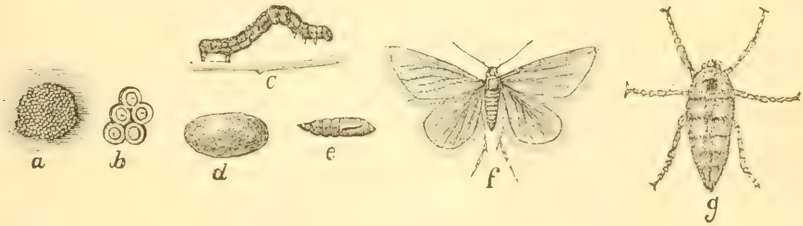

Fig. 29.

were identified for me through the kindness of Mr. A. H. Kirkland, B.Sc., assistant entomologist of the State Board of Agriculture, who made the examinations. Although it was impossible in all cases to learn with certainty the species to which certain insects belonged, it was evident that they belonged to the genera known to be of injurious habits.

I take the following from Mr. Bailey's notes:

Number of Eggs of the Fall Canker-Worm found in Stomachs of Chickadees.

No. 1	273 eggs.
" 2	261 "
" 3	216 "
" 4	278 "

Making in all 1,028 eggs found in the stomachs of four birds. Four birds killed later in the season had eaten the female imagos of the spring canker-worm (*Paleacrita vernata*), (Fig. 29, *g*), as follows:

No. 1	41 moths.
" 2	18 "
" 3	27 "
" 4	19 "

Making a total of 105. In No. 2, 3 and 4 of the last table there were a large number of eggs also. It is safe to say that there were 150 eggs in each stomach, in addition to the female moths eaten.

Mr. Bailey carefully counted the eggs in the ovaries of twenty of these female moths, with the following results:

No. 1	158	No. 11	111
" 2	272	" 12	160
" 3	127	" 13	193
" 4	184	" 14	131
" 5	213	" 15	281
" 6	135	" 16	242
" 7	140	" 17	116
" 8	220	" 18	281
" 9	200	" 19	192
" 10	130	" 20	217

It will be seen from this table that the average number of eggs found in each moth is 185. Mr. Bailey is very positive, from his continuous field observations, that each chickadee will devour on the average thirty female canker-worm moths per day from the 20th of March until the 15th of April, provided these insects are plentiful. If the

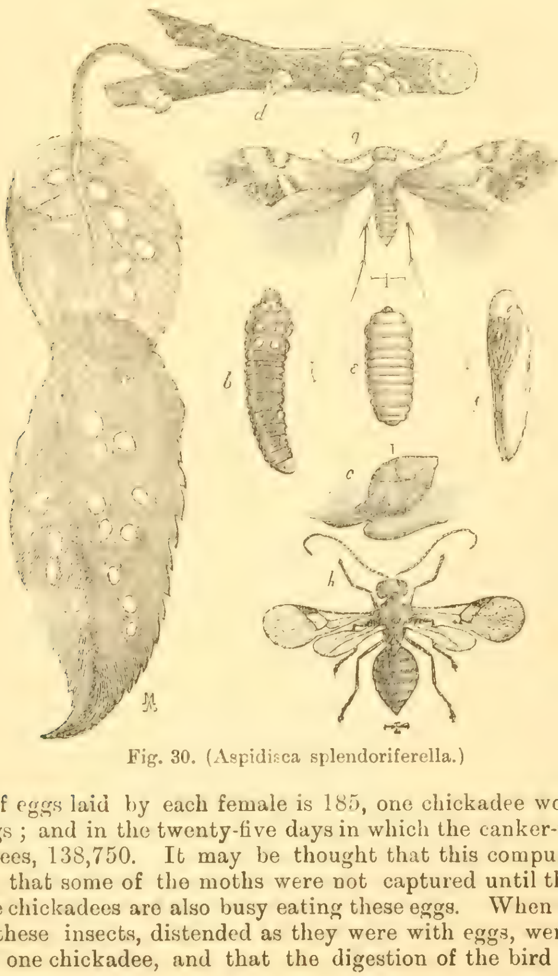

Fig. 30. (Aspidisca splendoriferella.)

average number of eggs laid by each female is 185, one chickadee would thus destroy in one day 5,550 eggs; and in the twenty-five days in which the canker-worm moths "run" or crawl up the trees, 138,750. It may be thought that this computation is excessive, and it is probable that some of the moths were not captured until they had laid some of their eggs, but the chickadees are also busy eating these eggs. When we consider further that forty-one of these insects, distended as they were with eggs, were found at one time in the stomach of one chickadee, and that the digestion of the bird is so rapid that its

stomach was probably filled several times daily, the estimate made by Mr. Bailey seems a very conservative one. He now regards the chickadee as the best friend the farmer has, for the reason that it is with him all the year, and there is no bird that can compare with it in destroying the female moths and their eggs. It was noticed that the birds made no attempt to catch the male moths. This, however, cannot be considered as a fault, for the birds accomplish far more by destroying the females than they would by killing males.

The following notes from the preliminary examinations of the contents of the alimentary canal of chickadees made by Mr. Kirkland are of interest in this connection :

"Bird brought in by Mr. Bailey, March 16, 1895: Gullet empty. Gizzard contained 270 canker-worm eggs (*Anisopteryx pometaria*), forty-six case-bearers (microlepidoptera), six cocoons, Fig. 30*d*, of a small tineid (near *Aspidisca*). These three kinds of food in bulk composed eighty per cent. of the gizzard contents, the remainder being dark material which I was unable to determine under a hand lens. I think it very probable that part of this was bits of bark or particles of bark dust taken in with the eggs or cocoons. The intestine contained a large quantity of meat, seventy-five per cent., and 103 canker-worm eggs, ten per cent., the remainder, fifteen per cent., being material which I could not identify. It was not meat. This gives us as totals, 373 canker-worm eggs and fifty-one microlepidoptera.

"Specimens of so called 'scales' on apple twigs brought in by Mr, Bailey, March 12, 1895. These are not bark lice, but the cocoons of a microlepidopteron, probably a tineid. Length 1-12 to 1-8 inch: width, 1-12 to 1-10 inch; elliptical, dark brown or reddish brown. They are closely spun, the upper surface apparently being of leaf epidermis, while underneath is a small well-formed cocoon which contains a minute green larva which evidently hibernates as such, probably pupating in the spring The larva undoubtedly feeds on the leaves of the apple-tree, as these cocoons were taken from the small twigs at the extreme end of a large branch. Some of these cocoons are empty and have a minute hole at one end, which probably served for the egress of some small parasite. These cocoons are eaten by the chickadee, and have been found in the gizzard of the birds."

The case bearers and the tineids or leaf miners are injurious to the foliage of the apple-trees.

It was noticed by Mr. Bailey, who watched the birds closely for several days, that they were eating quantities of both of these insects. It would have been impossible for any one to determine the species of the leaf miners as found in the birds' stomachs, for little remained but small fragments of the shell of the creature. Mr. Bailey noticed that the birds were taking objects from the twigs, some of which they ate; others they rejected and dropped upon the snow. Some of those dropped he picked up and examined, finding them to be parasitized. The birds undoubtedly ate only those which were alive.

It was evident from a careful examination of the eggs found in the stomachs of the chickadees that they were either broken by the bill in such a way that the contents were exposed to the action of the gastric juice or the gastric fluid destroyed a portion of the shell. Occasionally a few eggs which appeared to be whole were found in the intestines.

A great quantity of animal food is required to sustain life and provide animal heat sufficient to enable these little birds to resist the inclemency of our severe winters. In proof of this it may be stated that during favorable weather the birds visited the meat and ate largely of it three times each hour with fair regularity. During each interval they were occupied in destroying eggs and other hibernating insect forms which were always present and numerous in the stomachs examined. This feeding appeared to be almost continuous except in severe storms when the birds sought shelter or when they were laboring under excitement caused by fear, as in the case of a visit from a hawk, cat or shrike. Whenever a cat appeared they immediately hid behind the branches and remained quiet until the intruder had passed. The appearance of other enemies or the firing of a gun would produce much the same effect.

The woodpeckers and nuthatches which frequented the orchards, were not seen to eat the eggs of the canker-worm moth. As they were not numerous, none were killed. Mr. Bailey observed, however, that the nuthatches were eating scales which they found on the limbs of the apple-trees in a neighboring orchard. In relation to these scales the following note from Mr. Kirkland is of interest :

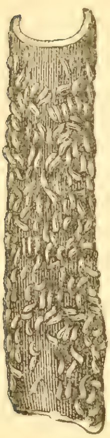
Fig. 31.

"March 20, 1895 Mr. Bailey brought in specimens of apple twigs infested with the Bark Scale louse, *Mytilaspis pomorum*, Fig. 31. He reported that the nuthatch was feeding on them. These twigs were infested in a worse manner than I have ever seen before. They were literally covered with the scales. On one small twig, one-half inch in diameter, I counted 367 scales on one inch of the twig. The eggs contained in a number of scales varied from sixty-two to eighty-two, with an average of seventy."

These scales, when numerous, are very injurious to the apple-tree. Each scale covered a dead female of the preceding year and the hibernating eggs, many of which must have been disposed of by the nuthatches. I was shown, both by observation and dissection, that birds feeding in the same neighborhood and upon the same trees showed considerable variance in the character of their food. Kinglets taken, had no canker-worm eggs, but had eaten largely of bark borers. Woodpeckers seemed to confine themselves to the larvæ of borers and to wood-ants and other insects which bore into the wood of the tree. Chickadees and nuthatches ate the pupæ and eggs of insects found upon the bark or in the crevices of the trunks. No birds were seen to eat the eggs of the tent caterpillar, nor were any found in the stomachs of any of the birds examined. It seems probable that these eggs are so protected by a hard covering that they are not eaten by most birds.

It is impossible, in the limited space at our command, to give results of all observations and dissections in detail. We can merely give the apparent results of the presence of the birds in the orchard.

It was found that these birds were not only destroying the eggs of the canker-worm in this orchard, but were feeding on the eggs of the same insect in the woods where bait had been suspended.

As the frost left the ground on the first warm days of spring the wingless females of the spring canker-worm moth appeared in the orchard and began ascending the trees in great numbers. The chickadees commenced catching and eating the females and their eggs. Mr. Bailey placed twenty-two of the females on one tree, and in a few minutes twenty of them were captured and eaten by chickadees.

It was noticed as spring approached and insects became more numerous that the chickadees came very seldom to the meat. They were not as assiduous in their attention to the orchard, and a small portion of their food consisted of the early gnats which were flying on bright sunny days. In early April they had nearly deserted the meat, although they still frequented the orchard in search of the female canker-worm moths. They seemed to prefer animal food to all other, and even in cold weather would hardly notice grain or seeds of any kind, though one individual ate a few oat kernels which were placed near his accustomed feed of meat.

Towards the last of April the English or house sparrow (*Passer domesticus*) began to make its appearance in the vicinity and apparently drove the chickadees to the woods, as they disappeared and did not nest in the orchard, but remained in the woods, where they paired and nested.

I believe that the English sparrow is largely responsible for the fact that chickadees are not now found nesting in our orchards. Though they still nest in the orchards on the remoter farms and in the villages where the English sparrow is not numerous, they seem to have disappeared in summer from orchards near cities. At the time of the advent

of the sparrow in this locality, twenty-five years ago, chickadees were often found nesting in old apple trees in the orchards in this region where now scarcely any are to be seen in orchards during the summer.

In the latter part of April and in early May the tent caterpillars made appearance on the apple and cherry trees in the neighborhood. Canker-worms were also numerous on the apples and elms and appeared in some of the other trees. It was noticed, however, that while trees in neighboring orchards were seriously infested with canker-worms and to a less degree with tent-caterpillars, those in the orchard which had been frequented by the chickadees during the winter and spring were not seriously infested, and that comparatively few of the worms and caterpillars were to be found there.

With the warm south winds of May, many summer birds came and settled in the neighborhood and prepared to build their nests, among which the following were seen: Chickadee (*Parus atricapillus*), Tree Sparrow (*Spizella monticola*), Crow (*Corvus Americanus*), Purple Grackle (*Quiscalus quiscula*), Flicker (*Colaptes auratus*), Red-winged Blackbird (*Agelaius phœniceus*), Robin (*Merula migratoria*), Chipping Sparrow (*Spizella socialis*), Ovenbird (*Seiurus aurocapillus*), Wood Thrush (*Turdus mustelinus*), Catbird (*Galeoscoptes carolinensis*), Brown Thrasher (*Harporhynchus rufus*), Black-billed Cuckoo (*Coccyzus erythropthalmus*), Yellow-billed Cuckoo (*Coccyzus Americanus*), Black and White Warbler (*Mniotilta varia*), Yellow Warbler (*Dendroica æstiva*), Chestnut sided Warbler (*Dendroica Pennsylvanica*), Black-throated Green Warbler (*Dendroica virens*), Pine Warbler (*Dendroica vigorsii*), House Wren (*Troglodytes ædon*), American Redstart (*Setophaga ruticilla*), Nashville Warbler (*Helminthophila ruficapilla*), Golden-winged Warbler (*Helminthophila chrysoptera*), Scarlet Tanager (*Piranga erythromelas*), Rose-breasted Grosbeak (*Habia ludoviciana*), Baltimore Oriole (*Icterus galbula*), Blue Jay (*Cyanocitta cristata*), Least Flycatcher (*Empidonax minimus*), Wood Pewee (*Contopus virens*) Phœbe (*Savornis phœbe*), Kingbird (*Tyrannus tyrannus*), and Downy Woodpecker (*Dryobates pubescens*).

It was noticeable that early in the season, when the webs of the tent-caterpillar (Fig. 27) first appeared on the apple and cherry trees, the orioles attacked them and devoured a considerable number of the hairy young larvæ. A little later, when the canker-worms became more numerous, it seemed as if all the birds in the neighborhood were intent on eating canker-worms, neglecting to a certain extent the hairy caterpillars. The cuckoos, however, seemed to feed impartially on both the canker-worm and the tent caterpillar.

Birds from all quarters in the wood and swamp, orchard and field, flocked into the trees infested by canker-worms, and there spent a considerable portion of their time. In a short time the few canker-worms remaining in the old orchard were apparently eaten by birds, and the birds then directed their attention to the neighboring orchards, which were swarming with the worms It soon became evident that these orchards would be entirely stripped of their leaves, while the old orchard retained its full foliage. Thus it was seen that the trees to which the chickadees had been lured during the winter had been so well protected that the summer birds were able to destroy the few remaining larvæ, while the trees at a distance from these contained so many larvæ that the birds were not numerous enough to dispose of them or to make any effective reduction in their numbers. This apparently demonstrated the usefulness of the egg-destroying winter birds, and showed the wisdom of attracting them to the orchard during the winter months. Not only did nearly all species of birds in the neighborhood flock to the trees infested by the canker-worms, but the chickadees, living in their retirement in the woods, came out to the orchards, flying some distance to procure canker-worms with which to feed their young, and making regular trips to the infested trees day after day.

On May 18, Mr. Bailey saw a female chickadee carry twenty larvæ to its nest. They were apparently all canker-worms but two, which were tent caterpillars. Of this he is certain, for he was within three yards of the nest to which the larvæ were taken. Later, on May 31, he noticed the chickadees feeding their young. It was evident that a large portion of the food consisted of canker-worms. The birds each made a trip to the nest about once in twelve minutes. The male and female came at nearly the same time

and went away together. They went in the direction of an orchard infested by canker-worms. A few of the larvæ were dropped on the ground at the nest and proved, on examination, to be canker-worms.

The crow was also observed feeding on the canker-worms.

On May 22 the birds had nearly all stopped feeding in the neighboring woods and were in the orchards feeding on canker-worms.

Early in June, when the remaining canker-worms had finished their transformations and retired to the ground, several species of birds were again noticed feeding their young on the tent and other hairy caterpillars. Of these, three species (both cuckoos and the Baltimore oriole) seemed to be the most useful. On May 17, a cuckoo was seen to take eleven caterpillars out of one nest. Mr. Bailey writes: "On May 10, a black-billed cuckoo came into a tree near me at 3 p.m. and sat there until 4.40 p.m., then he went straight to a tent caterpillars' nest. He looked it over for a short time and then commenced eating the caterpillars. He picked twenty-seven caterpillars out of the nest before he stopped. The bird ate them all and did not drop one. Then he went to the tree, in which, I believe, he remained during the night, for on Saturday, the 11th, I found the bird in the same tree, and in almost the same place, at 5 a.m."

The orioles, chickadees and vireos often pecked the caterpillars to pieces and ate portions of them, seemingly feeding to a considerable extent on the internal organs. This being the case, it is quite evident that the stomach contents cannot be depended upon entirely to determine the character of the food of these birds, as no one is expert enough to identify the internal organs of caterpillars with such certainty as to determine the species to which they belong.

The following is a list of the birds seen feeding on the tent caterpillar:

Crow (*Corvus Americanus*), Chickadee (*Parus atricapillus*), Oriole (*Icterus galbula*), Red-eyed Vireo (*Vireo olivaceus*), Yellow-billed Cuckoo (*Coccyzus Americanus*), Black-billed Cuckoo (*Coccyzus erythrophthalmus*), Chipping Sparrow (*Spizella socialis*), Yellow Warbler (*Dendroica æstiva*).

During the month of May an attempt was made to render the place as attractive to birds as possible. The undergrowth, which previous to 1894 had been trimmed out, was afterward allowed to grow, and in 1895 several low thickets had been thus formed. The mulberry-trees were stimulated by judicious trimming, and bore a considerable crop of early fruit which ripened in advance of the cherries, thus drawing the attention of the fruit-eating birds away from the cherries, and serving to attract them to the vicinity of the orchard. Ten nesting boxes were put up for the wrens and bluebirds; but as the bluebirds were very rare this season none came to the orchard. Two families of wrens, however, were reared in the boxes in place of one family last year. Nesting materials—strings, hair and straw—were hung in the trees and scattered about. Several marauding cats were killed, and an attempt was made to keep nest-hunting boys away from the neighborhood as much as possible. Thirty-six nests of birds were discovered in the neighborhood, as follows: Three red-eyed vireos, ten robins, four Baltimore orioles, three cuckoos, five chipping sparrows, three least flycatchers, two redstarts, two yellow warblers, two chickadees, two house wrens.

Of these all but three were destroyed probably by boys, the nests being torn down and the eggs missing. The three which escaped destruction were two wrens' nests which had been built in boxes upon buildings, and a robin's nest in a maple tree within ten feet of a chamber window. This wholesale destruction of nests discouraged several pairs of birds, and they disappeared from the neighborhood. Those remaining built new nests, and after a second or third attempt a few succeeded in rearing young. One nest of orioles escaped the general destruction, and the birds were busy for a long time carrying canker-worms to their young. One of them was noticed to take eleven canker-worms in its beak at one time, and fly with them to the nest. The vireos, warblers, chickadees, cuckoos, orioles and chipping sparrows were particularly active in catching canker-worms, and the English sparrow killed them in considerable numbers.

If the thirty-six pairs of birds whose nests were found had succeeded in raising their young, it is probable that they would have disposed of most of the canker-worms in the neighborhood. Five thousand of these larvæ are sufficient to strip a large apple-tree. One hundred and eight young would have been reared, had each pair of birds raised three. According to Professor Augley's experience, sixty insects per day as food for each bird, both young and old, would be a very low estimate.* Suppose each of these one hundred and eight birds had received its sixty insects per day, there would have been 6,480 caterpillars destroyed daily. The destruction of this number of caterpillars would be enough to save the foliage and fruitage of one apple-tree. In thirty days the foliage of thirty apple trees could have been saved, or 194,400 canker-worms destroyed. This does not include what the old birds themselves would have eaten.

In these observations, the influence of insect parasites and predaceous insects has not been entirely ignored. Hymenopterous parasites were not seen to be numerous, and as it was a year when canker-worms were on the increase, it is not probable that these parasites would have been a prime force in reducing the numbers of the canker worms had the birds not been present. Even had they been numerous they would have had little effect in checking the ravages of the canker worm during the present year, as their interest is identical with that of the canker-worm, and they remain in its body until it has finished feeding, allowing it to defoliate the trees before completing their deadly work upon it.

We do not know to what extent such parasites are devoured by birds. This we could not ascertain without shooting the birds, which would have defeated our main object. No parasites of the tent caterpillar or canker-worm were found in the stomachs of the few birds which were examined. It is hardly safe to draw conclusions from observations so limited in their scope, but we may infer from what was observed that the egg-eating birds are of the greatest value to the farmer, as they feed almost entirely on injurious insects and their eggs, and are present all winter when other birds are absent. The summer birds which attack the larvæ are valuable also if they can be so protected and fostered as to become sufficiently numerous to do the work required. It is evident also that a diversity of plants which encourages diversified insect life, and assures an abundance of fruits and seeds, as an attraction to birds, will insure their presence. In this connection, I wish particularly to note the fact that the mulberry trees, which ripen their berries in June, proved to be a protection to the cultivated cherries, as the fruit-eating birds seemed to prefer them to the cherries, perhaps because they ripen somewhat earlier.

I believe it would be wise for the farmer to plant rows of these trees near his orchard, and it is possible that the early June berry or shad berry (*Amelanchier Canadensis*) might also be useful in this respect. It is a handsome shrub or tree, flowering early in the season, and would be attractive at a time when other trees and shrubs are not in bloom.

At the present time, July 23, 1895, the trees in the orchard appear to be in good condition. They have not suffered from the slight pruning of their foliage which was effected by the few caterpillars and canker-worms which survived. The fruit is well set, and it now remains to be seen whether the birds will have any considerable effect in preventing the ravages of the codling moth. No other orchard in the neighborhood will produce any fruit this season, with one exception. The nearest orchard, situated directly opposite on the estate across the way, has not been ravaged by the canker-worms. This exemption is due principally to the efforts of the owner, who has banded his trees with tarred paper and has used tree ink faithfully and well upon the paper. He has also taken pains to clear the nests of the tent caterpillar from the trees. This orchard, being nearest to the one visited by the chickadees, was also an object of their attention, and this may account somewhat for the reduction of the pests in this place.

The record of these observations, incomplete as it is, is given for what it is worth as a contribution to the literature on this most interesting and important subject.

* 1st Rep. U. S. Ent. Com. 1877, p. 342.

THE ROCKY MOUNTAIN LOCUST AND ITS ALLIES IN CANADA.

By Samuel H. Scudder.

The genus Melanoplus, to which the Rocky Mountain Locust belongs, forms part of a small group of genera first definitely separated a few years ago by Brunner von Wattenwyl under the name of Pezotettiges, but which, for reasons given in a technical memoir now in press, I have preferred to call after the dominant genus just mentioned,—Melanopli.

In the last resort, the Melanopli are separated from their nearest allies only by such an apparently insignificant matter as the number of spines (in itself variable) found on the outer margin of the hind tibiæ; these, save for individual exceptions, often on one side of the body only, are always at least nine in number and rarely exceed fourteen. In the known Canadian species they range from eight to thirteen, but ten or eleven is the almost invariable number.

The Melanopli are an almost exclusively American group comprising more than thirty genera of which only one, Podisma, occurs in the old world. They are primarily divided into two sections, dependent on the shape of the subgenital plate of the males, a division

Fig. 32. Locust (magnified.)

which broadly but not exactly separates the tropical or subtropical genera from those of the temperate regions, and leaves an almost equal number of genera in each section. Of the tropical section, as it may be called, but a single genus is known in Canada, Hypochlora; its single species *H. alba* (Dodge) is reported by Brunner as occurring in Manitoba, and this is altogether probable as it ranges along the border in the United States from Minnesota to Montana, but extends south only to Kansas and Colorado. It is a slender, hoary green, long-legged insect with abbreviated tegmina, and is partial to the white sage, *Artemisia ludoviciana.*

Of the temperate section, only three of the genera are actually known to inhabit Canada, though, as we shall see, there is little doubt that others will be found there. One of these is Podisma, formerly known as Pezotettix*, a genus remarkable among the Melanopli for its longitudinal range, which is around the globe north of Lat. 35° N.; for its penchant for high altitudes, many of the species occurring only above or at the forest line on high mountains; and for the wide separation of its sternal lobes, though this alone will not separate it from all Melanopli. Moreover its organs of flight are never completely developed and may often be altogether wanting, as may then also, though in none of our American species, the tympanum found on the sides of the first abdominal segment; as this tympanum is regarded as an auditory apparatus, and as the power of producing sound is gone with the loss of the tegmina (against which the femora are scraped,) the absence of the tympanum in some apterous European species would seem to indicate that they had departed the more widely from the original type, and had therefore a longer history behind them.

*See Psyche, vii, 195.

Up to the present time more species of Podisma are known from the old than from the new world; in the latter they are not known over a continuous territory, but over two large areas, one in the east and one in the west. That in the east is inhabited by only two species, one of which is only known from Ithaca, N.Y., at less than 500' above the sea, while the other, the better and long known *Podisma glacialis* (Scudd.,) was first found at the timber line in the white mountains of New Hampshire, and has since been obtained at high elevations 2-4500' above the sea, in Maine on Ktaadn and in the country about the Megalloway, in New Hampshire on Kearsarge in Bartlett, in Massachusetts on Greylock in Berkshire county, and in New York in the Adirondacks; while Mr. James Fletcher and I came across it at the edge of the town of Sudbury in Ontario. It will doubtlesss be found also in Quebec if sought in the proper places; it is not found upon the ground but upon bushes, in the white mountains on the dwarf birch. Bruner also credits it to "British America," but I do not know from what point he received it, and on enquiry I find it was probably a mistake.

The western area from which Podisma occurs has half a dozen species, which range along the rocky mountains from New Mexico to Alberta; all of the species are found on the mountain slopes or in Alpine valleys, and most of them at or above the timber line. A single species only is known to inhabit Canada, *Podisma Oregonensis* (Thom.,) which has been taken at Fort McLeod in Alberta, and is also known from Montana, Idaho and Oregon. It is highly probable that other and possibly new species will be found in the Canadian Rockies; it is especially likely that *Pod. dodgei* (Thom.,) one of the commonest alpine orthoptera in Colorado, and known also from Wyoming and Montana, will occur near timber line in Canada.

A second genus of the section which occurs in Canada is Phœtaliotes, a group founded by me for a single species, the somewhat anomalous insect *Phœtaliotes Nebrascencis* (Thom.,) of which *Pezotettix megacephala* Thom., *Pezotettix autumnalis* Dodge, and *Caloptenus volucris* Dodge, are all synonyms. It has a large, prominent, tumid head, which with a subsellate pronotum gives it a peculiar appearance; it is strikingly dimorphic, full-winged and half-winged, which accounts for a part of the synonymy. In Canada it has been found only in Alberta at Fort McLeod and in Assiniboia at Medicine Hat, but it ranges from here, skirting the eastern slope of the Rocky Mountains, to Texas and even to Central Mexico. I have not seen the long-winged form, volucris, from Canada, but it occurs from Mexico to Montana.

We have left for the last (though in systematic sequence it should have preceded Phœtaliotes) the typical, dominant genus Melanoplus, which contains most of the known Canadian species. This genus is so strikingly dominant as to contain more than one-half of the known Melanopli of the world. In the memoir referred to at the outset, I have described in detail no less than 131 species, all from North America and all but a very few found within the limits of the United States; it finds its principal home in the west, and it is to this genus that the Rocky Mountain Locust and several other minor depredators belong. To handle the genus properly I found it advisable to separate it into twenty-eight groups or series, defined mainly in terms of the male abdominal appendages, which here attain a striking and highly diversified development, and to name the groups after the predominant or older species contained in it. In that order I will present them also in the present account. Many of these species have before been placed under Pezotettix (Podisma) when I and others were accustomed, without careful discrimination, to look upon all the short-winged forms as belonging to that genus and the long-winged ones to Melanoplus. As some species are dimorphic, either fully winged or practically unable to fly from the brevity of the alary organs, that custom had its disadvantages, and a careful study of our entire Melanoplan fauna became a great desideratum, which I trust I may be found to have successfully filled in the paper before referred to.

In the *Glaucipes series*, there is a single species, *Mel. kennicottii* Scudd., a very small full-winged insect, which must be tolerably widespread in Canada, since it has been brought from the Yukon river in Alaska and the Souris river in Assiniboia, and occurs also in Montana.

In the *Utahensis series*, *Mel. bruneri* Scudd., a new species of about the size and general appearance of *Mel femur-rubrum* but the male with a strongly upturned, apically broad subgenital plate occurs in Alberta at Fort McLeod, and extends from there southward to Nebraska and Colorado, and westward to Washington.

But it is in the *Spretus series* that the largest number of Canadian species appear. Most of them are closely allied to *Mel. atlanis*. Here are, first, *Mel. Alaskanus* Scudd., a new species found in Alaska and taken also at Spilmacheen, British Columbia; next, *Mel. affinis* Brun., another new species found in British Columbia, Washington, Utah and Wyoming; then, *Mel. bilituratus* (Walk.,) a common species on Vancouver Island, as well as on the mainland in British Columbia, and over the border in Washington, Oregon, Nevada and Montana; *Mel. atlanis* (Riley,) an extremely abundant insect, occurring throughout the breadth of Canada, from Sable Island, off Nova Scotia, to Vancouver; it extends northward to the Yukon river in the west, though in the east I have only seen or heard of it as far north as Quebec, Ottawa, Sudbury and Lake Winnipeg; and finally, *Mel. spretus* (Uhl.,) the Rocky Mountain Locust, the arch-destroyer, whose home is in the high plateaux of the Rocky Mountains and their eastern versant as far north as the Saskatchewan, and which now and again ravages the country to the east by its migrating hordes.

In the *Dawsoni series* there are two Canadian species: *Mel. Dawsoni* (Scudd.,) which occurs in Canada from Manitoba to Alberta, and has two forms, long-winged and short-winged. Only the latter has been found in Canada, and the species ranges to New Mexico. The other Canadian species is *Mel. Gladstoni* Brun., which has been found at Medicine Hat in Assiniboia, and southward to Nebraska. Both these species are small and inconspicuous.

In the *Fasciatus series* are also two Canadian species: *Mel. fasciatus* (Walk.,) widespread in Canada, having been reported or seen by me from Newfoundland, Labrador north of the Straits of Belle Isle, Anticosti, Hudson Bay, Lake of the Woods, Manitoba, Saskatchewan, Assiniboia, Alberta and Alaska. It also occurs in the United States everywhere near the Canadian border, from ocean to ocean, and as far south as New Jersey, Missouri and Colorado. It again is dimorphic, but the wings in the brachypterous form are not very short, and the full-winged form is known only from Michigan. The second species of this group is the only Canadian species not found in the United States, *Mel. borealis* (Fieb.) I have seen it only from the barren grounds of northern Labrador, but it is also reported from Hudson Bay and Greenland. It has slightly abbreviated organs of flight.

In the *Femur rubrum series* the well known *Mel. femur-rubrum* (DeGeer), Fig. 33 occurs over nearly the whole of Canada, from ocean to ocean, wanting only in some northernmost localities, such as Labrador; and a second species, *Mel. extremus* (Walk.), ranges from Quebec to the Yukon and is dimorphic, though the organs are half as long as the body in the brachypterous type. The macropterous form seems to affect high altitudes or latitudes. I have seen specimens from the Alpine districts of the White Mountains and from Arctic America, among other places.


b
Fig. 33.

In the *Angustipennis series* the only Canadian species is *Mel. coccineipes* Scudd., a new species of moderately large size, found not uncommonly in Nebraska, Kansas, Colorado and Utah, and of which I took some specimens in company with Mr. Fletcher, at Nepigon, Lake Superior.

Mel. packardii Scudd., is the only Canadian species of the *Packardii series*, but this occurs abundantly from Assiniboia to British Columbia. South of the border it occurs over most of the United States west of the 100th meridian.

In the *Collinus series*, where all the males have forked cerci, there are several Canadian species: *Mel. alpinus* Brun., a very small new species, which ranges from Alberta to British Columbia, and is also known from Idaho; *Mel. infantilis* Scudd., a still smaller form, originally described from Colorado, but found also in Assiniboia (Medicine Hat),

and Alberta (Fort McLeod); and *Mel. minor* (Scudd.), a tolerably common species in the United States from Maine to the Rocky Mountains, and which was long ago sent from Red River, Manitoba, by Robert Kennicott and Donald Gunn.

Finally, in the *Bivittatus series*, where the species are large (the largest of those found in Canada), we find *Mel. femoratus* (Burm.,) which ranges from Nova Scotia to British Columbia, and extends as far north as Hudson Bay. In the United States it extends southward nearly to the Ohio, and on the Atlantic coast even to North Carolina, while in the west it is nearly confined to the northern tier of states, though it reaches along the Rockies to Colorado and along the Sierras to northern California. A second species, intimately related to the other, but with parti-colored instead of clear red hind tibiæ, *Mel. bivittatus* (Say), is a more southern form, but it occurs with the first in many places, and, in Canada, accompanies it from British Columbia to Manitoba, but not eastward.

It thus appears that ten of the twenty-eight series found in the genus Melanoplus occur in Canada, though but twenty species, or less than one-sixth of the known forms, are included in the list. The list is remarkable for three things: 1, the range of structural diversity as indicated by the number of series represented; 2, the total absence of all species with excessively abbreviated tegmina (*i.e.* only as long or scarcely longer than the pronotum), such as would formerly have been placed unquestioned in Pezotettix, the single one of the known Canadian Melanopli with such tegmina being a true Podisma; 3, that it includes three of the only four well marked cases of wing-dimorphism in the genus Melanoplus. It is true that both the dimorphic forms have not been found in Canada, but that is in all probability a mere accident, collections from Canada being much rarer. The dimorphism is probably co-extensive or nearly so with the species.

But it should not be concluded that the above list actually offers a fair idea of the true Melanoplan fauna of Canada. Canada is so little explored from a natural history standpoint, especially in its western portions where, in the United States, Melanopli are so very strikingly diversified, and so many additional forms have been found next the Canadian border, that we must believe that many of them surpass it and are not now known as Canadian, simply from the little attention paid in Canada to this order of insects. We propose, therefore, to conclude this account by a brief review of such Melanopli as may be looked for with some confidence; we shall discover the probability of a much more varied and numerous series, for the number of genera and species will both be doubled, and the "series" of the genus Melanoplus represented raised from ten to seventeen. All the additional genera, however, belong to the temperate section.

In the first place we may cite Hesperotettix as a probable inhabitant, since *Hesp. pratensis* Scudd., is widely diffused along the northern margin of the United States, from Minnesota to Washington, being recorded in my paper from these two States and all the intervening ones.

Then there is the genus Bradynotes, containing peculiarly broad-chested, robust forms with mere pads for tegmina, all the species of which are confined, so far as known, to the extreme northwest of the United States,—Washington, Oregon, Northern California and Idaho, with Nevada, Montana and Wyoming. No less than four species are found in Washington and two others in Idaho, besides one confined to California, so that it seems altogether probable that one or more of them may be found in British Columbia, if indeed this district do not prove to have its peculiar species.

The genus Œdaleonotus, founded by me on the species I formerly described as *Pezotettix enigma*, a clumsy bodied insect with tumid prozona and stout femora, and strikingly dimorphic in its tegmina, ranges on the Pacific coast from Southern California to Northern Washington where it is abundant, and it may almost surely be looked for in British Columbia.

Another new genus, Asemoplus, created for the reception of Bruner's *Bradynotes Montanus*, a relatively slender form, likewise with lobiform tegmina, has been found hitherto only in Montana and Washington and not further south, so that it probably ranges northward across the boundary.

To turn to the genera known to be represented in Canada, we have already mentioned the probability that *Podisma dodgei* (Thom.,) would occur in the Canadian Rockies; and it is by no means improbable that new species of this genus will also be found.

But for the bulk of the suspects we must naturally turn to the genus Melanoplus. Here, in the *Flabellifer series*, we have *Mel. occidentalis* (Thom.,) known from Minnesota, North Dakota, Wyoming and Montana; and *Mel. flabellifer* Scudd., occurring in Wyoming, Montana and Idaho.

In the *Spretus series*, *Mel. intermedius* Brun., occurs abundantly in Wyoming, Montana, Idaho and Washington, and is, therefore, likely to occur in Alberta and British Columbia.

The *Indigens series* is composed of a single and new species, *Mel. indigens*, which comes from Idaho and may reasonably be looked for a little further north.

The *Mancus series* is another group not yet discovered in Canada, but which may be looked for, as two species, *Mel. Artemisiæ* (Brun.,) and *Mel. mancus* (Smith) are found on its confines: the former in the west on sage brush in Idaho; the latter in the east in Maine and New Hampshire.

In the *Dawsoni series*, an additional species may be looked for, viz: *Mel. militaris* Scudd., which occurs in Idaho.

Several species also of the *Rusticus series*, a group not yet recognized in Canada, probably occur therein: *Mel. Montanus* (Thom.,) found in Montana, *Mel. Washingtonianus* (Brun.,) known now only in Washington, and *Mel. altitudinum* (Scudd.,) which occurs at high elevations in Wyoming, South Dakota and Montana.

Of the *Borckii series*, *Mel. borckii* (Stål.,) is found in Washington, Idaho and Montana.

So, too, in the *Fasciatus series*, *Mel. saltator* (Scudd.,) occurs in the same States and in Wyoming, and may confidently be expected to extend across the border.

The *Alleni series* contains but two species, one of which, *Mel. Alleni* (Scudd.,) occurs in Iowa and Dakota.

One of the representatives of the *Cinereus series*, *Mel. cinereus* (Scudd.,) is of a very wide range, and is known from Washington, Idaho and Wyoming in places very similar to those abundant over the border in the sage-brush district.

Finally the *Collinus series* has probably other representatives in Canada, since *Mel. luridus* (Dodge) occurs abundantly in Washington, Montana, Dakota and Wyoming, and *Mel. collinus* (Scudd.,) is found in equal numbers in Maine and New Hampshire.

A considerable number of these species have tegmina no longer than the pronotum, so that should eventually all of them be found in Canada, what has before been said on this point regarding Canadian species would need to be materially modified. But in any event it seems plain that the Canadian fauna will prove much richer in species and genera than we now know it to be.

It should be added that many of the species mentioned above are as yet unpublished and are not always so specified; descriptions of all are in press.

SEVENTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.*

The Association met in room 4, High School building, Springfield, Mass., August 27th, 1895. The following officers and members were present:

President John B. Smith, New Brunswick, N. J.; Vice-President, C. H. Fernald, Amherst, Mass.; Secretary, C. L. Marlatt, Washington, D. C.; R. A. Cooley, Amherst, Mass.; G. C. Davis, Agricultural College, Mich.; E. H. Forbush, Malden, Mass.; L. O. Howard, Washington, D. C.; A. H. Kirkland, Malden, Mass.; J. A. Lintner, Albany, N. Y.; C. V. Riley, Washington, D. C.; P. H. Rolfs, Lake City, Fla.; F. A. Sirrine, Jamaica, N.Y.; E. B. Southwick, Central Park, New York City; F. M. Webster, Wooster, Ohio; C. M. Weed, Durham, N. H.

There were also in attendance upon the meetings members of other scientific associations and entomologistis not members of the Association, among the latter Mr. George Dimmock and Professor Macloskie. The attendance at the different meetings ranged from 20 to 40.

The Association was called to order by the President and reports from officers listened to. The amendment to the constitution proposed by Mr. Summers, November 13th, 1890, but not afterwards taken up, was adopted. It reads as follows:

SEC. 3. The membership shall be confined to workers in economic entomology. All economic entomologists employed by the General or State governments, or by the State experiment stations, or by any agricultural or horticultural association, and all teachers of economic entomology in educational institutes, may become members of the Association by transmitting the proper credentials to the Secretary and by authorizing him to sign their names to this constitution. Other persons engaged in practical work in economic entomology may be elected by a two-thirds vote of the members present at any regular meeting of the Association. Members residing out of the United States or Canada shall be designated foreign members. Foreign members shall not be entitled to hold office or to vote.

The following persons were elected active members of the Association:

Mr. W. Hague Harrington, Ottawa, Canada; Mr. R. E. Palmer, inspector of fruit pests, British Columbia. Proposed by Mr. Fletcher.

Mr. W. S. Bullard, Bridgeport, Conn.; Mr. John Gifford, State forestry agent, Mays Landing, N.J. Proposed by Mr. Howard.

Mr. E. A. Schwarz, Washington, D.C. Proposed by Mr. Marlatt.

Mr. E. H. Forbush, Malden, Mass.; Mr. A. H. Kirkland, Malden, Mass.; Mr. R. A. Cooley, Amherst, Mass. Proposed by Professor Fernald.

Mr. F. W. Urich, honorable secretary Victoria Institute, Trinidad, and Trinidad Field Naturalists' Club.

The annual address of the President, John B. Smith, was entitled "Entomological Notes and Problems." He drew attention to the fact "that differences in results obtained by farmers do not always argue ignorance or carelessness, and that insects or insecticides may vary, either in resisting power or in effectiveness, in different localities, and that we must not hastily conclude that what answers in California will be equally effective in New Jersey, nor that the conclusions based upon the most careful experiments made in New York can be accepted unquestioned in Idaho," and stated, "that there are factors not yet understood by us that should make us cautious in recommending too positively or hastily measures based on results reached in localities different from our own, and on the other hand should make us very chary in condemning work done by a confrere because our results do not agree with his."

"The day of testing insecticides is therefore not so nearly over as has been sometimes thought, and we owe it to our constituent, where his results do not agree with our expectations, to test the matter under his conditions before deciding him incompetent; and it does not need the distance between the Atlantic and Pacific to make a difference in condition. Results obtained annually by dozens of farmers in New Jersey seem absolutely

*Through the kindness of Mr. L. O. Howard, Entomologist of the Department of Agriculture, Washington, D.C., we are enabled to give the following account of this interesting meeting.

unobtainable by most careful experiments made in New York ; while I have this season proved, much to my dissatisfaction, that the reverse may be equally true, for I can not secure the results in actual practice with bisulphide of carbon against cabbage maggots which Mr. Slingerland obtained in his experiments. Yet Mr. Slingerland undoubtedly recorded only what he found, and sooner or later the reason for the failure in New Jersey will be discovered. Each worker must therefore study his own field most carefully."

He next took up the question of how to control the publication of entomological matter in newspapers in order to prevent the dissemination of erroneous statements, and mentioned the difficulties that he encountered in his efforts to do so. He then referred to the impossibility of keeping track of everything that is published on economic entomology, referring not only to bulletins and reports, but also to the articles published in agricultural journals and newspapers, and asked whether there might not be some feasible way of interchanging among the members of the Association, records of all articles containing original or useful information. He also suggested that some arrangement should be adopted for the interchange amongst the members of specimens of injurious insects and their work, and also the formation of a central collection of economic entomology.

He then dealt with the subject of legislation against insect pests and referred to the difficulty of arousing public opinion sufficiently in order to secure action. He also dwelt upon the importance of having some kind of inspection of trees and shrubs grown in nurseries before they were sent broadcast over the country.

"Perhaps I have spoken enough of problems and of difficulties—he went on to say—and should mention some of the accomplishments, some problems solved. Unfortunately there are none. Progress there has been in many directions, and of the most encouraging kind, but no striking successes, no epoch-making discoveries. We have not yet succeeded, for instance, in dealing more satisfactorily with grasshoppers ; but it is decided progress to learn that in a single State several hundred 'hopper-dozers' are in use under the direction of the entomologist and that the State has realized the importance and necessity of this kind of work. Our good friend and fellow-member, Dr. Otto Lugger, has certainly succeeded in securing respect for his profession and a reduction of his preachings to practice.

"Chinch bug work continues in a number of States ; but we are not much nearer a final decision concerning the actual value of the Sporotrichum as a destructive agent. The chief objection to it seems to be that it requires the intelligent co-operation of the weather to secure the best results, and the weather is notoriously unreliable except in so far that you may count with reasonable certainty that it will not be as you want it.

"In this very State of Massachusetts we have a striking example of a destructive increase of an imported pest—the gypsy moth—and an interesting experiment in the direction of its destruction by the State. There are to be two papers on this subject, I am informed, and there will probably be a discussion on the principles concerned in the matter of dealing with imported pests. But I will take the liberty of offering just a few remarks here, not on the methods employed, but on the general principles involved. Under our scheme of government the individual States jealously reserve to themselves all matters of internal interest, and the Federal authorities are excluded from all save a fairly well-determined class of subjects. But no State seems to owe any duty to its neighbors, and Connecticut cannot force Massachusetts to protect it from an invasion by any Massachusetts pest, nor can it claim damages for any resulting injury. Each State is thrown upon its own resources for the protection of its own citizens. Connecticut took no steps to restrain the spread of the pear midge, and New York and New Jersey, though they are sufferers by the neglect, can make no complaint ; but these States have in turn left the matter to individual effort, and Pennsylvania and Delaware, when their turn comes, will most likely adopt the same policy of non-interference. There is nothing, in other words, to prevent the spread of this insect over the entire United States except the limitations imposed by nature itself. Just what they are remains to be seen.

"Massachusetts owes no duty to other States to protect them from the gypsy moth. She owes a duty to her citizens only, to the extent that her citizens in a legal way them-

selves determine by their own representatives. If in protecting themselves they protect their neighbors also, they deserve no credit for this result and have no claim for assistance. Yet it is a very grave question whether Massachusetts is not entitled to the assistance of her neighbors or of the general government in her efforts to exterminate this insect. I am offering no opinion as to the possibility of extermination—I have expressed myself both ways and cannot find another—but is not this really a matter of national importance, and should not the national government have certain duties or powers in cases of this kind?

"It is said that nothing is wholly bad, and so I find it possible to see a good feature even in the continued spread and increased injury caused by such imported pests as the elm leaf-beetle. I believe that this creature has done more to arouse public interest in economic entomology than any other single factor for many years past Our cities are the centres of public interest nowadays, and our metropolitan press voices its expression. Insect injury to agricultural products rarely excites more than a passing curiosity, but the depredations of shade-tree insects in streets, parks, or near-by country roads, and on the grounds surrounding country houses attract attention immediately and produce loud and continuous complaints. The press is interested, and through it the public, while those most vitally affected, the owners of fine shade trees, are induced to examine into a question which they would otherwise have considered as of not the least practical interest. It is from this point of view that I welcome the recent great spread and increased injury from this elm leaf-beetle. City and town authorities and village improvement societies have taken up the matter, have inquired into it, and have even made some more or less successful experiments; and these, if continued, as they must be from the nature of the case, will produce an increased interest in and appreciation of economic entomology. Insecticide machinery and a knowledge of the application of remedial measures against the more common pests will be required of each park department and its employees, and the entomologist will be as important an officer as the landscape gardener. * * *

"I have noted an increasing tendency of late to attempt the control of insect pests by methods of cultivation or farm practice, and this, in my opinion, is much to be commended. There are periods in the life histories of many insects when they can be easily reached if we only know how, and where resort to some simple bit of field practice may prevent injury. A good example of this is seen in the practice of cutting close to the surface all shoots of blackberry about June 20 to prevent injury from the *Agrilus ruficollis*. All the eggs have been laid at that time, and the new shoots will be exempt, of course, while the larvæ cannot develop in those that have been cut down and will die. The whole matter seems so simple now, and yet it is less than two years ago that this was practiced almost simultaneously in New Jersey and Ohio.

"Preventing injury from the larvæ of *Melittia ceto* in late squashes by planting summer varieties upon which the eggs are laid and in which the larvæ are afterwards destroyed is another method which has been worth many hundreds of dollars to farmers on Long Island and in New Jersey.

But there is yet much to be done in this direction, and I am convinced that in the future "circumvention" will be practised in many cases where we now use poison. Farm practice, using this term in its widest sense to include the mechanical treatment of land, selection of fertilizers, date of planting and harvesting, rotation of crops, etc., will in time give us control of many injurious species which at present seem beyond our reach. It must be our aim to ascertain as far as possible the circumstances least favorable to the development and maintenance of the troublesome species, and then our attempt must be to produce just those conditions.

"We should, I think, whenever possible, lay great stress upon the importance of destroying crop remnants when they are no longer needed. For instance, cucurbit vines are usually left on the ground after all the crop is off, affording abundant opportunities for the maturing of *Anasa tristis*, the melon lice, and other pests. Removing them when no longer needed and destroying will save much trouble during the year following. Systematically burning potato vines as soon as the crop is harvested will prevent all

danger of injury from the potato-stalk weevil (*Trichobaris 3-notata*), and I might cite many other cases were it necessary. We should also set out the advantages of winter work against many kinds of insects in orchard, vineyard and garden, and the desirability of destroying by fire everything that comes under the head of rubbish. Especially against certain kinds of hemiptera this sort of work would prove effective, and fire, judiciously used, can be made a valuable friend. So, much of the pruning should be done at this season, where the character of the plant warrants it, and if the cuttings be burnt many ova of insects will be destroyed. But I am telling you old facts which you do not care to hear. My purpose was not to offer them as information, but to urge their more forcible presentation to the farmer, and to indicate that in my opinion the future development of our dealings with insects will be along this line. * * *

"On the whole, I may repeat, we have rather cause for congratulation than otherwise. Our favorite branch of scientific investigation has made continuous and healthy progress; we have firmly established the reason for our existence and have impressed the general public with a dawning of appreciation for the work we are doing. Our session here will, I doubt not, improve our standing, and will at all events be profitable to those taking part."

Professor Fernald discussed interstate entomological problems with particular reference to the gypsy moth and the attempts to get the work against this insect undertaken by the General Government. He referred also to the difficulties arising from the conflict of interests of different States.

The first paper on the list, "Notes on Insecticides," was read by Mr. C. L. Marlatt, in which he described at length a series of experiments that he had made in order to thoroughly test the various apparatus that had been designed for spraying with kerosene oil and water, the results of which were not entirely satisfactory. He then treated of various insecticides, viz., soaps, arsenate of lead, cyanide of potassium and arsenite of copper.

AFTERNOON SESSION—AUGUST 27, 1895.

A paper by Mr. H. E. Weed on "Some Experiments with the Knapsack Kerosene Attachment," was read in his absence by Mr. Davis. In it the writer set forth the advantages that are claimed for the use of this mechanical mixture of kerosene and water over the familiar kerosene emulsion. It was followed by a paper by Mr. Clarence M. Weed on "A Modification of the Kerosene Knapsack Sprayer," in which he reported a series of tests of the knapsack sprayer with kerosene attachment, showing that the principal machine now on the market is unreliable in its present form. The chief source of error appears to be due to the continual differences of level in the kerosene and water tanks. To avoid this a kerosene attachment had been made at the New Hampshire Experiment Station, and was exhibited, of the same height as the water reservoir and holding one-tenth as much. A stopcock with a single hole one thirty-second of an inch in diameter connected the kerosene reservoir with the pump. By this arrangement a fairly constant spray having nine per cent. of kerosene in it was obtained. The opinion was expressed that to get successful results we must abandon the idea of having a large range of variation in one combination of reservoirs—*i e.*, in expecting to get either a five per cent. or a thirty per cent. emulsion by turning a stopcock at a less or greater angle. The author believed that the kerosene sprayer was capable of great improvements along the lines indicated, and thought it too great an advance in methods of insect warfare to be lightly abandoned.

The following communication on "Spraying Without a Pump," by Mr. J. M. Aldrich, was in the form of a letter to the Secretary, accompanying a working sample of the apparatus. The apparatus itself and the manner of working it were described by the

Secretary with the aid of blackboard illustrations. The following is an abstract of the letter:—The spraying device which was suggested by the author to the association last year was again presented to call attention to two changes in the machine from the first idea. First, it is necessary that the stream from the hydrant enter the lance within rather than beyond the entering point of the insecticide; second, the Nixon nozzle is entirely inapplicable to this form of apparatus, for the reason that it chokes the flow so as to destroy the suction in the insecticide tube. No nozzle has yet been devised free from this objection, except a plain deflector tip. The author is aware that a deflector does not give so good a spray as can be obtained in other ways, and hopes yet to overcome this objection.

The spraying device consists of a sort of lance, forked at the base. One fork connects with a hose to a hydrant or water supply under pressure, and the other with a tube leading into the vessel containing the insecticide. Both forks are provided with stopcocks. The suction caused by the passage of the water through the lance induces a flow through the fork and hose leading from the insecticide.

To use the apparatus, attach to an ordinary lawn hose by the large coupling. Turn on the city water, and it will be at once perceived that there is a strong suction through the small or insecticide tube. Put the end of this in a pail of water or kerosene, and, in the case of the apparatus experimented with, sixteen per cent. of the total discharge comes through it, the stopcock being wide open. By partly turning off the stopcock the proportion of kerosene can be reduced at pleasure, and the percentage may be indicated by graduations on the back part of the stopcock.

For Paris green, make up a pailful at the rate of one pound to twenty-five gallons of water, and when drawn through the machine it will be diluted at the eight per cent. kerosene gauge mark to one pound to 150 gallons and thoroughly mixed.

The device was experimented with by the inventor with a water-pressure of seventy-five pounds, which was inferred to be an average for city water.

No claim to novelty for this device was made except in the application. The principle is the same as that in the "jet pump" used for draining out barges, cellars, etc.

If the instrument deserves any name, it is suggested that it be called the Idaho jet sprayer.

Discussion of the foregoing papers followed. Mr. Southwick had canvassed the question of spraying from hydrants in his work in Central Park, New York, but had found it impracticable on account of the insufficient pressure of the water and the small number of hydrants. He said he was devising a steam pump which he hoped would give greater satisfaction than any apparatus hitherto used.

Mr. Davis suggested that any apparatus dependent on a constant water supply, as of hydrants, would be more feasible in the West in connection with irrigation plants.

Mr. Howard remarked that a stream produced by a pressure of seventy-five pounds to the square inch, mentioned by Mr. Aldrich as obtained from his hydrants, was quite sufficient to kill insects, with the exception of scales, without the addition of oil.

Mr Lintner asked if the oil and water mixture referred to in the various apparatus described in the papers could be properly considered an emulsion.

Mr. Marlatt said that an oil emulsion was merely the breaking up of the oil into minute globules in the emulsifying agent, and that on this basis the water and oil mixture, as long as permanent, was as properly an emulsion as the kerosene and milk mixture. He referred also to the fact that emulsions are often made with solid ingredients, as powdered lime.

Mr. Southwick referred to a nozzle which had lately come under his observation, which effects the mixture of the insecticide element with water at the moment of spraying. He had not yet experimented with it.

Mr. Marlatt said that from the description Mr. Southwick undoubtedly had in mind the Gillmore nozzle (to which Mr. Southwick assented), and said that Mr. Gillmore was at the Department, and some very careful tests were made with this nozzle with various insecticide agents. The character of the nozzle and the practical objections to its use were then pointed out.

Mr. Forbush said he knew of a similar principle at one time employed by a fire apparatus company to mix a fire extinguisher with water at the moment of spraying.

Mr. Smith said it was very encouraging to see such decided interest taken in the manufacture and improvement of machinery for the application of insecticide mixtures. He was of the opinion that the origination of new devices and the work of perfecting old ones or overcoming mechanical difficulties may be safely left to manufacturers, whom he had always found very ready to adopt suggestions in the matter of the betterment of apparatus. In this connection he referred also to the adoption by the Climax Pump Company of an improvement in the kerosene knapsack sprayer suggested by Mr. Goff. His experience with the improved knapsack sprayer, he said, corresponded very closely with that detailed by Mr. Marlatt.

Mr. Marlatt, referring again to the device suggested by Mr. C. M. Weed, pointed out that while the arrangement of the kerosene and oil reservoirs suggested by this author would probably obviate several of the difficulties, still an important objection, arising from the oil escaping into the water chamber during the action of the pump or immediately thereafter, was not corrected by this means, although possibly rectified by the combination suggested by Mr. Goff in a communication in Garden and Forest of April 10, 1895.

Dr. John B. Smith read the following paper :

"Raupenleim" and "Dendrolene."

"Raupenleim" and "dendrolene" are both crude petroleum products of a butter-like consistency at ordinary temperatures and becoming only slightly softer at high temperatures. The raupenleim is a German product, very dark in colour, with a tarry odour and probably mixed with some tar preparation. The American product is brown in colour, almost without odour, and without foreign admixture to disguise its character or give it a specific smell. Raupenleim is largely used in Germany to protect trees from the attacks of certain insects and to prevent their being injured by stock or deer during the winter. The materials were tested comparatively for the purpose of preventing borers from attacking fruit trees, and if possible to prevent their issuance when already under the bark. Both materials can be readily applied with a paddle or trowel and distributed by means of a stiff brush so as to make a tolerably even coating. Experiments showed that it did not injure even young shoots where applied to the bark only ; but where buds or growing tissue were covered it killed the buds and shoots by choking the stomata. A young tree set out in 1894 was covered from the surface of the ground to the buds without detracting from its vigour during the balance of the season. It was applied upon an orchard of pear trees infested by the sinuate pear borer and both materials prevented oviposition. The raupenleim absolutely prevented the issuance of all the beetles maturing under the bark. The dendrolene did the same where thoroughly applied. The raupenleim has a tendency to harden on the surface. This is a good thing where it is intended to prevent beetles from issuing from the trees, but a bad thing where it is intended to prevent insects from crawling up the trunk. The dendrolene becomes very soft at high temperatures without running. This prevents insects from crossing it; but where it is applied thin it does not always form a barrier to insects emerging through the bark. Its application is recommended as against the fruit bark-beetle (*Scolytus rugulosus*), which can not emerge through it when already in the tree, and can not enter the bark protected by a coating. It was also tested against peach borers, and both materials proved effective.

It was stated by the grower conducting the experiments that the dendrolene killed the borers that were in the tree when it was applied, while the raupenleim did not. This fact may have been accidental and is not to be expected under ordinary conditions. The material is recommended for application to fruit trees to prevent attacks of round and flat-headed borers, and also wherever it is desirable to prevent insects from ascending or descending the trunk. A broad band, put on thickly, is recommended against the codling moth, and, in cities, against the white-marked tussock moth and the bag worm. It is suggested that applied on trunks on which insects like the pear psylla hibernate it will destroy these insects by preventing their coming out in the spring.

The cost of the raupenleim, free on board in New York city is, for twenty five pounds, $3.75 ; fifty pounds, $6.75 ; one hundred pounds, $12.75 ; barrel, from 250 to 275 pounds net, about $25. Dendrolene is supplied free on board at six cents a pound in New Brunswick, N. J., in lots of twenty-five to fifty pounds, and at 5½ cents in lots of one hundred pounds and over. The material can be washed from the trunks of the trees if desired by a strong potash mixture, say one pound of potash in a gallon of water. As the substance is a mineral product, it does not become rancid.

In answer to a question as to the composition of the lime, Dr. Smith stated that it was chiefly, if not entirely, crude mineral oil.

Mr. Southwick read extracts from a letter from agents for an imported insect lime, which were very extravagant in statement.

Mr. Fernald said he had experimented with the lime against the spring cankerworm, in conjunction with other experiments with printer's ink, the latter applied on paper bands, and banding the trees also with cotton, two or more bands being placed on the same trunk. Very few worms passed over the cotton bands, considerable numbers over the ink bands and a few over the lime. The larvæ chiefly effected their passage over the latter on cool mornings, which indicates that very diverse effects may be expected in different climates. He thought that of the three substances experimented with the imported or raupenleim gave the best results.

Mr. Howard asked what period of the year was included in the five months during which the lime was on certain trees.

Mr. Smith replied that they were the five months immediately preceding the middle of July.

Mr. Lintner suggested that the lime be so thinned down that it could be sprayed, to facilitate application.

Mr. Smith stated that this thinning would be especially desirable for work against scale insects, but that even when considerably thinned it could not be sprayed through an ordinary spraying nozzle.

Mr. Forbush said he had not his notes with him and therefore could not give in detail his experience with lime, which had been very extensive. He had used the raupenleim and an American material, Menzel's brand. He had found considerable difference in imported material obtained in different years. Sometimes it had proved very unsatisfactory and he had discontinued its use for other methods which he deemed more advisable for his work. He said that some insects can cross the lime, but when it is warm, and especially on sunny days, it is a nearly perfect barrier. On cold days, and particularly in stormy, rainy weather, insects can pass it with comparative ease. On smooth bark it will run somewhat, and will also crack or break, especially on rough-barked trees. German authors, he stated, claim that no injury results to the trees from its application, and his own experience was confirmatory of this. The only injury he had noticed came from the scraping prior to the application of the lime or injury from the lime as a result from such scraping of the bark. On dusty streets the lime soon crusts over and may be crossed by insects, and pine needles adhering to it produce a similar result. It is claimed by some that limed trees are not frequented by birds, but this idea was not confirmed by his own experience. He had used various machines and various devices had been constructed by the commission for the application of the

lime. The necessity in cities or public parks of applying the lime at considerable heights on the trunks to prevent contact with it on the part of passers-by rendered many machines for its application impracticable for his purpose, and he had been compelled to employ chiefly paddles and trowels. European machines were found to be crude and somewhat unsatisfactory. He said that in Europe the lime was employed also as a coating for egg masses to prevent the escape of the larvæ. The objection to this was that such egg masses were very apt to be broken open by squirrels and the larvæ thus enabled to escape at the proper time. He thought lime would be of value, particularly against the canker-worm. He had found in certain instances that after lime had been exposed on trees during summer and winter the following spring it was still of a consistency to be of service.

Mr. Smith said that the dendrolene referred to in his paper is entirely without odour, whereas the European lime smells very strongly of tar. He was of the opinion that this odour was given to the European product to conceal its true composition.

Mr. Davis had tried wool bands with parallel experiments with raupenleim against canker-worms, and found the latter successful in every instance; but this could not be said of the wool bands. He had found lime impracticable against cut-worms, many of them crawling over it in the cool of the evening; and it had not proved entirely satisfactory against the peach borer, as the borers frequently emerged in spite of the coating of lime.

Mr. Smith said that this would be very probably the case if the application were made to the peach after the larvæ were in the tree, but that the application would be more successful if used to deter the moth from ovipositing.

Mr. Southwick said that in his experience he had found the tussock moth larvæ so numerous that they had been able to crawl over the lime on account of mere numbers.

Mr. Smith said this would not occur in the case of young larvæ.

Mr. Forbush said larvæ would bridge over any band when very numerous, and that such a result could only be prevented by visiting the bands and collecting at frequent intervals the larvæ accumulated beneath.

Mr. Smith said that the American product referred to in his paper was less affected by extremes of temperature than the European lime. He was convinced that in insect lime we have a valuable means of defence against many insects, but that there was room for considerable improvement at present.

Mr. Forbush said that while he had discontinued it for other reasons, he believed that there were great possibilities in the proper use of insect lime.

Mr. Fernald, referring to the Russian lime, said that all the material probably came originally from Germany.

Mr. Smith stated that the constituent elements of the lime very possibly came from the oil regions of Russia.

Mr. Marlatt said the Department of Agriculture had received samples of this raupenleim, and called attention to the very strong similarity between this substance and ordinary axle grease, both in odour and physical qualities, and suggested that the composition of the lime was probably very similar to that of axle grease. He said that in applications to trees as against scale insects, and wherever applications were more generally made than by mere banding, the after effect on the tree would probably be disastrous, although it might not develop for some months. Experiments with other oils on trees gave a strong probability in this direction.

Mr. Smith said the insect limes would very probably turn out to be material similar to axle grease. The dendrolene referred to by him was a Standard Oil Company's product, and would very likely appear under different names as coming from different houses, although all would obtain their supply from the Standard Oil Company. As applied to old bark, which had no vital function, subsequent injury need not be feared.

Mr. Howard referred to the press reports of the loss by a Kentucky orchardist of a thousand valuable peach trees from the application of linseed oil, with other ingredients, as a preventive to the borer. The recommendation which led to the application was charged to the Department of Agriculture, this charge proving, however, by the man's own admission, to be unfounded.

Mr. Davis remarked that a similar remedy had been recommended by the United States Pomologist to the fruit growers of Michigan.

Mr. Smith called attention to the necessity, in reporting results, of giving adequate explanations, instancing the danger of confusion in the use of the term "emulsion" arising from the different kerosene emulsion formulas used as a case in point.

Mr. Forbush gave further results obtained by the commission in the use of lime against the gypsy moth and against the tent caterpillar, all indicating the value of lime. He also described the method of clearing out underbrush as a means of starving out the larvæ.

Mr. Howard said the starving-out plan was the one principally relied on in the work against the nun moth in Austria. Trees of considerable size were banded with the insect lime to prevent the ascent of the larvæ, and all low-growing vegetation was then absolutely destroyed and the larvæ perished for want of food. He further said that there are certain species of plant lice which descend the trunks of trees in autumn and ascend again in spring, against which bands of lime could be used to advantage. This would be particularly the case with the species common upon the tulip tree.

Mr. Lintner, referring to the difficulty of preparing a good emulsion, suggested the advisability of someone's undertaking the preparation of the emulsion as a merchantable article, spreading its benefits to the general public, who were not sufficiently skilled or equipped to undertake its home manufacture.

Mr. Smith said that some patented insecticides very closely imitated the kerosene emulsion, but were more expensive than their cost of manufacture warranted; but he agreed with Dr. Lintner as to the desirability of having the standard emulsion on sale.

Mr. Howard said that where an appropriation was available the superintendents of parks might make the emulsion and distribute it free of charge, as had been done in New Haven.

Mr. Southwick read a paper entitled "A City Entomologist and Insecticides."

The paper was discussed briefly by Messrs Smith and Howard.

Mr. Smith, discussing the work of Scolytus, stated that they normally attack weakened or unhealthy trees, and that a vigorous tree would require very considerable work by Scolytus to seriously injure it.

Mr. Lintner said he understood from Mr. Davis that the trees were thus diseased and unhealthy.

Mr. Davis replied that some of the trees were thrifty and others lacked vigour.

Mr. Rolfs referred to the great numbers of Scolytus which followed the disastrous frost of last winter in Florida, causing great alarm among fruit growers. He said, however, that the trees attacked were such as were greatly injured by the frost and would probably have died anyway from the effects of the latter, and that the beetles were always present though rarely injuriously abundant.

Mr. Howard said that it is well known that in the absence of sickly trees Scolytus will attack healthy and vigorous trees, and that the present large numbers of Scolytus are therefore a constant menace.

Mr. Smith said he had been informed by Mr. Schwartz that the beetles will enter healthy, vigorous trees, but are unable to successfully propagate in them.

Mr. Lintner said that Professor Peck had found them attacking perfectly healthy spruces.

Mr. Smith, referring to the climbing cut-worms, said that he had been frequently called on to determine for correspondents moths described as having been bred from climbing larvæ. He had received several such from Mr. Slingerland. He questioned if they did not adapt themselves to differing conditions, sometimes assuming the climbing habit, while perhaps normally working on the ground.

Mr. Howard reported that the species *subjuncta* and *scandens* had been repeatedly sent in this year as climbing cut-worms.

Mr. Sirrine asked if all cut-worms did not climb as young larvæ, giving his experience with cabbage cut-worms as sustaining that view.

Fig. 34.

Mr. Smith said that this is the habit of *Carneades messoria* Fig. 34, on onions. In this connection he urged the value of personal observation to impress one with the true significance and importance of the working habits of insects. In illustration of this he referred to his having recently witnessed a grasshopper invasion in the west, which had brought to him a realization of the possibilities of this insect to which before he had been a stranger. He said also that the Hessian fly, commented on by Mr. Davis, had proved very much more numerous in New Jersey this year than in years recently passed.

Mr. Lintner said this fly was also very abundant in western New York.

Mr Howard said this is distinctively a Hessian fly year, and that the division had recently issued a circular to facilitate answering the numerous inquiries received on the subject.

The following paper by Mr. Chittenden, was read by Mr. Sirrine :

Herbivorous Habits of Certain Dermestidæ.

The Dermestidæ, as is well known, feed chiefly upon dried animal substances. Certain species, however, are reported to have injured vegetable material, and a few recorded instances of damage of this character are cited. Until very recently the various species of household Dermestidæ had not been suspected of actually breeding in other than animal substances, but the experiments of the writer indicate that they subsist also on a vegetable diet.

The larva of *Attagenus piceus*, or black carpet beetle, was received in cereals from various sources, and was finally brought to the attention of the writer in such manner as to lead to a suspicion that it might feed, at least occasionally on vegetable substances. Adult insects were confined in a jar of flour and meal, and their progeny were found to thrive upon this material. This species was also found to breed in timothy seed, and incidental mention is made of serious injury to bolting cloth by it in a mill at Georgetown, D. C. A brief review of the history of this insect in America, where it has been known since about 1806, is given, and instances of its reported occurrences in granaries are citied.

Trogoderma tarsale Melsh., a common museum pest, was found to infest flaxseed, castor beans, and cayenne pepper that had been on exhibition in the museum of the United States Department of Agriculture, the larva being reared from the egg deposited in these substances and the adults having been bred from other larvæ feeding on them.

An unknown and evidently recently imported species of Trogoderma was stated to be living in flaxseed, castor beans, and silk worm cocoons with the above-mentioned species, and in red-clover seed This species is believed to have been introduced at Washington in the silkworm cocoons. It has been taken in New Mexico and will probably be found to have established itself elsewhere in the United States.

Anthrenus verbasci Linn, our most abundant insect cabinet pest, was reported as occurring in "middlings" and spoiled flour, and the fact mentioned that at the time of writing larvæ placed in flour were feeding upon it, from which it was judged that they would in due time reach the adult condition.

In conclusion it is stated that in the case of the Attagenus and Anthrenus, these insects were probably first attracted to granaries by the presence of weevils and other grain insects, and that the graminivorous habit is an acquired one. The presence of Trogoderma in oil seeds and red pepper, however, admits of no other explanation than that of the absence of animal food, and shows a wonderful adaptability to unnatural environment.

Mr. Howard said that the buffalo moth does not occur in Washington, its place being taken by *Attagenus piceus.* He asked for the experience of others as to the former insect to determine its southern extension. *A piceus,* he said, is not so troublesome as the buffalo moth but is yet a serious pest. In answer to a query from Mr. Davis he gave a brief description of the larvæ of the two species.

Mr. Lintner, referring to the popular designation of the insect as the "buffalo moth," said that he had often urged the discontinuance ot the use of this misnomer and thought an effort should be made to secure popular acceptance of a more appropriate common name for this species. He thought it not so strange that Dermestidæ fed on vegetable material, since many species having an altogether animal feeding habit in the larval state are vegetable feeders as adults, instancing the feeding of larvæ of various species on woollens and other animal products, the adults of which feed on pollen.

Mr. Fernald discussed the use against these insects of inflammable and explosive insecticides in connection with its bearing on insurance policies and was inclined on this latter account, not to recommend them. He gave the method of controlling the pest followed with success by his wife, as follows : (1) Before bringing flowers into the house thoroughly shake them to dislodge the beetles. (2) Regularly collect and destroy the beetles which emerge and gather on the windows of the house during the months of March and April. (3) Carefully treat the carpets on the upper floors of the house, as the beetles commonly enter through the upper windows, and these carpets act as traps, getting the first and the bulk of the invasion.

Mr. Davis said his wife had been unsuccessful in the use of similar remedies.

Mr. Rolfs said that the work of the carpet beetle was much worse in the South than in the North, but he did not know the species. He used carbon bisulphide or cyanide gas, preferring the latter. If used with caution he thought neither of these substances dangerous, and their use was especially desirable in connection with herbariums.

Mr. Lintner said that he ordinarily recommended kerosene, which he thought more suitable than gasoline. Before laying new carpets all the grooves should be carefully filled with cement or plaster, and the carpets should be left loose at the borders to facilitate frequent investigation. The use of tarred paper was also advisable. He had found the following trap method valuable ; Remove all woollens from rooms or closets and scatter about them bits of red flannel, which is a very attractive bait for the Anthrenus. The beetles thus attracted are afterwards collected and destroyed. Referring to Mr. Fernald's statement regarding the method of entrance of the beetles from flowers out of doors, he said that this is a common experience and that they commonly enter houses through the upper windows and appear first in the carpets of the upper rooms, thus making their reappearance after having been exterminated.

Mr. Fernald discussed the subjects of the relation of colour in woollens or carpets to infestation by the buffalo moth, and said that it had been carefully investigated by his former assistant, Mr. Lounsbury, as to the attractiveness both of particular colours and different dyes to the beetles. The information was sought from various sources, including factories for the manufacture of carpets and rugs. The conclusion arrived at was that colour is not an important factor—at least the beetles do not confine their attacks to

particular colours, though showing a preference for the greens. He thought it more likely that the preference exhibited by the beetles in certain cases was due rather to the mordant employed.

Mr. Howard said that the best remedy and the one which he now always advised, was to abandon the use of carpets altogether.

Mr. Smith had used the method suggested by Mr. Davis and had also employed gasoline. He had not found anything in insurance policies against the use of this or like substances in small quantities, but he was always careful to urge the greatest caution in the use of inflammable substances. He gave, by request, certain experiences which he had had with the use of bisulphide of carbon in the National Museum, a rather serious explosion having in one instance occurred from the ignition of this substance by the heat from a steam radiator, while there was another equally startling case of the ignition of the substance in a large box, resulting from a spark having been struck off from a nail in fastening down the lid of the box in which the bisulphide had been placed. In the latter case the box exploded and the negro laborer was either thrown a distance of some feet or had leaped a considerable length under the excitement of the moment.

Mr. Howard asked Mr. Taylor, a visitor present, who is engaged in the manufacture of bisulphide of carbon, if he knew of any cases of accident from the use of this substance.

Mr. Taylor replied that he knew of but one case of serious results, and that was where an explosion had resulted from a stroke of lightning. He was inclined to think that with ordinary precautions the danger was trifling. He said that the substance will ignite at 220° F.

Mr. Smith said that the radiator referred to by him was not nearly so hot as that.

WEDNESDAY MORNING—AUGUST 28th, 1895.

Mr. L. O. Howard read a very interesting paper on "Some Shade-tree Insects of Springfield and other New England Cities," in which he treated especially of the elm-leaf beetle (*Galerucella luteola*), and the Woolly Maple leaf Louse (*Pseudococcus aceris*), and traced their progress throughout the region referred to.

Mr. C. L. Marlatt followed with a paper on "The Elm-leaf Beetle in Washington," in which he described the methods pursued by the Division of Entomology to protect a grove of elm trees in the grounds of the Department of Agriculture from the ravages of this destructive insect.

Another paper descriptive of the history and injuries wrought by the same insect at Albany, N.Y., was read by Mr. J. A. Lintner, State Entomologist.

A long and interesting discussion followed in which most of the members present took part.

At the afternoon session Professor Fernald gave an extended account of the operations of the Gypsy Moth Commission in Massachusetts. (See 25th Annual Report, 1894, page 67, for a description of this insect, and the methods adopted to keep it in check.) In response to a request Mr. Kirkland, assistant entomologist to the Gypsy Moth Commission, gave a verbal report on the more recent experiments with insecticides conducted by the Commission. He said that no success had been had with insecticides until the arsenate of lead had been devised, and even this, at the rate of ten pounds to 150 gallons of water, effected the destruction of only about fifty per cent. of the larvæ. He described his examination of the alimentary canal of the larvæ, with a view to determining the probable action of the juices contained in various parts of the canal on insecticide substances. He had found the juices strongly alkaline, and of the substances which seemed most likely to be acted upon by an alkaline liquid he had considered the cyanides of different metals to be the most promising. The cyanides of lead, antimony, copper, zinc,

iron, manganese, mercury, etc., were considered. The cyanides of antimony and copper, on theoretical grounds, seemed to promise best. The cyanide of antimony was totally without effect at the rate of 10 pounds to 150 gallons of water. Cyanide of copper was fairly effective, but too expensive for practical employment, three pounds to 150 gallons being with this substance equivalent to one pound of Paris green to 150 gallons of water, or three or four pounds of arsenate of lead to 100 gallons. Even where no practical results seem to have been obtained, as in the above series of experiments, he pointed out the value of the negative results ; in that the very fact that the merits of these substances valuable for insecticides is better understood and limited. In connection with the various experiments with insecticides he had occasion repeatedly to emphasize the extreme vitality of the gypsy moth larva and its immunity to the action of poisons.

Mr. Riley discussed the gypsy moth question at considerable length. He said he had always been much interested in the gypsy moth work, and referred to the orginal conference called by the State Board of Agriculture of Massachusetts, giving an account of this meeting, and of the suggestions made by himself and others as to means of controlling the insect. These suggestions were necessarily based on experiences with our well known common insects having somewhat similar habits, and had no basis in any actual experience with the insect under discussion. He had recommended and believed that the use of the arsenites is one of the most practical and effective means of control. There can now be no doubt, however, that this insect is an exceptional one, and probably can not be controlled by means which are quite effective against other insects, enemies of our trees, having similar habits. Emphasizing the great damage which may be done by this insect, he was convinced that its control and destruction are not only extremely necessary to the State of Massachusetts, but are also of national importance. He had always been in favor of extermination rather than of attempting to limit and control, but he pointed out the very great difficulty of exterminating the species if the work is mainly directed toward the destruction of the eggs, referring in this connection to his early statement in this regard, in which the destruction of the eggs had not been deemed of prime importance He thought, however, that in this particular he had been too extreme. He pointed out the absolute futility of any efforts at extermination which did not promise complete results. All that he had said in criticism of the Commission had been relative to the operations prior to Professor Fernald's controlling connection with the work. He heartily appreciated the value of the present methods as detailed by Professor Fernald. He felt that if at the outset a supreme effort had been made, with the aid of a very large appropriation, complete extermination of the insect could have been accomplished. He gave a summary of some early work and his criticism of it. He was somewhat inclined to question whether we are now justified in working on the basis of extermination through a State commission, or whether it would not be better to encourage the efforts of private individuals wherever the insect occurred, as is the case with other insect pests. He complimented very highly, however, the present work of the Commission. In discussing the subject of parasites, which had been referred to by Mr. Fernald, he was not inclined to agree with the idea that the aim of the commissson at complete extermination detracted at all from the necessity of undertaking the importation of foreign parasites. He said that such introduction could be accomplished at comparatively slight expense and would aid just so much the object of the Commission, pointing out also the greater usefulness of European parasites over native ones if introduced without secondary parasites. This would be particularly evident if his idea of the greater value of the destruction of the larvæ rather than the eggs were conceded.

In illustration of the great weight and value of Professor Riley's ideas on this subject, Mr. Fernald referred in the most complimentary way to the value of his long years of labor in the field of economic entomology, which had resulted in a store of information used and appreciated by all the workers of the world at the present day. He gave some statistics of the injury capable of being done by the gypsy moth in the State of Massachusetts, basing his deductions on the value of farm products and the estimated value of forest and shade trees (Mr. Lintner interjecting in the latter connection that the Saratoga elms were insured by the State at $500 each). Taking the probable injury from

this moth as a basis, he pointed out that a comparatively trifling tax only would be necessary to raise a sum sufficient to control the pest, and was very strongly of the opinion that the work of the Commission should be upheld and continued.

Mr. Howard said he was familiar with the work of the Commission and had gone over the territory and examined the methods of procedure in detail somewhat recently, and was convinced that anyone, seeing the operations and the results already reached, would be impressed with the fact that the work is now being done in the best possible way and according to methods which are most likely to accomplish the ultimate extermination aimed at. He offered a resolution regarding the work of the Commission, which was subseqently acted upon by the Association.

Mr. Lintner said he had been one of the first called to inspect the work and the conditions of the work, and had been deeply impressed with the amount of exertion necessary and the difficulties of successfully prosecuting it. He also had been most favorably impressed with the value of the methods at present employed. Whether ultimate extermination would prevail or not was at present, of course, merely a matter of opinion, but he was convinced of the necessity of continuing the work on the basis of extermination rather than mere control.

The next paper was read by Mr. Lintner on the striped "Cottonwood Beetle" in which he drew attention to the threatened destruction of the basket-willow industry of Onondaga and some other counties of western New York, from the ravages of an insect which has long been known as the striped cottonwood beetle, *Lina scripta* Fabr., but which hitherto has not been regarded as injurious. After describing the insect and its habits, and giving an account of the willow industry and its commercial importance he related the methods which had been made use of to control the insect and especially drew attention to a mechanical contrivance, called a "bug catcher" which had proved very effective for the collection and destruction of the beetles.

Mr. Webster read a somewhat technical paper on the probable origin of the genus Diabrotica. This was followed by a paper by Mr. Hopkins of Morgantown, West Va.

ON THE STUDY OF FOREST-TREE INSECTS.

The study of the insects affecting forest growth, from an economic standpoint, is in many respects a unique branch of economic entomology, which should in our opinion be designated by the term "forestry entomology."

The importance of advancement of knowledge in this particular branch of science may be inferred from some references to the character of insect injuries to forest growth; to estimates of the amount of damage and the annual pecuniary loss occasioned by such injuries; to the limited knowledge of this class of insects, and to the possibilities of preventing a large per cent. of the loss by the adoption of simple, practical methods of combating the pests.

Character of Injuries.

The injuries to forest growth may be separated into two classes, those affecting the living plants and those affecting the dead or dying plants. Of the former we have injuries to the foliage by leaf-eating, leaf-mining, sap-sucking, and gall-making insects; to the twigs and branches by sap-sucking, twig-mining, bark and wood boring insects; to the trunk by bark and wood-boring, and to the roots by wood-boring, bark-boring and sap-sucking species; the effect of the injuries thus caused upon the living plant being either destructive or detrimental to its growth or usefulness.

The injuries of a destructive character are those caused by insects which occur in sufficient numbers and make their attack in such a manner as to destroy or weaken the vitality of the tree sufficient to be the prmiary cause of its death.

The injuries of a detrimental character are those which are detrimental to the health, perfect growth, or future usefulness of the tree or its product, but do not cause its death.

Of the injuries affecting the dying and dead trees we find, as among those affecting the living, some which are of a destructive character, while others are simply detrimental. The destructive injuries are those caused by wood boring insects, which render the wood worthless for any practical use to man. The detrimental injuries are those which produce defects in the wood and hasten the decay of the affected parts.

Character and Extent of Damage to Forests by Insects.

Few persons who have not given considerable thought to the subject realize the serious character of insect depradations upon our forests and forest products. This is evident from the fact that the subject is seldom discussed at the meetings of forestry associations and is rarely referred to by writers upon forestry economy in this country.

If we were to assert as our belief that the annual damage and loss occasioned by insects to owners of forest and forest products in the United States was greater than that caused to the same by fire, few persons, if any, would believe that it could be possible. Yet when we come to consider the varied losses resulting from insect depredation, both in a destructive and detrimental manner and in the general influence of their work upon the forest economy of the country, we believe that such an assertion would not be far from correct.

The pine and spruce killed by bark beetles over vast areas in New England and in the Southern States within the last few years has caused an enormous loss of valuable timber; yet this is only a small portion of the damage to timber by insects. That caused in oak by the oak timber worms (*Lymexylon sericeum* and *Eupsalis minuta*), the Columbian timber beetle (*Corthylus columbianus*) and the carpenter moths of the family Cossidæ, to the chestnut by the chestnut timber worm (*Lymexylon sericeum*), and to the tulip and other kinds of timber by the Columbian timber beetle, all of which attack living trees, will equal that caused by many forest conflagrations. Then when we come to consider the damage to the wood of dying, dead and felled timber, and the work of destruction only begun by fire and completed by wood-boring species, it appears to us that the damage caused by insects is at least equal to that caused by fire.

There is also another feature of the question, and that is in reference to the effect of the detrimental and destructive ravages of forest insects upon the forestry economy of the country. Owing to the large amount of timber destroyed and rendered defective by insects, it is necessary for the manufacturers to cut over a larger area than would otherwise be necessary in order to supply the demand for the best grades of lumber and other timber products. According to a statement by Hon. J. Sterling Morton at the last meeting of the American Association of Agricultural Colleges and Experiment Stations, the area cut over every day in this country to supply the demand for forest products is 30,000 acres. From our observation in the lumber regions of West Virginia it would indicate that at least ten per cent. less timber might be cut each year for this purpose were it not for the detrimental ravages of insects upon the standing and felled timber. Therefore, in this item alone the annual loss to the country and to the manufacturer is enormous, for it must be remembered that a large per cent. of the defective lumber is manufactured and disposed of at a loss to the manufacturer, and is often the cause of serious loss to the consumer.

No accurate estimates of the pecuniary losses caused by forest insects can be made. Yet with the knowledge gained on the subject from recent investigations of the ravages of forest tree insects, from correspondence with lumber manufacturers upon the subject, and reference to the statistics of forest products, we feel justified in presenting some figures which will at least indicate the extent of the loss.

We would estimate the loss caused by bark beetles of the family Scolytidæ, which have caused the death of pine and spruce trees over vast areas within the last ten years,

at an average of $5,000,000 per year ; by bark and timber beetles of the Scolytidæ family causing defective wood in felled timber, $1,000,000, and by the same in timber injured by fires and other causes, $1,000,000 ; by the Columbian timber beetle to standing and living timbers, an average of $1,000,000 per year ; by the oak timber worms and the carpenter worms to the different species of oak, an average of $2,000,000 per year ; to chestnut timber by the chestnut timber worm, which is rendering one of the most valuable woods almost worthless, an average of $1,000,000 ; by wood borers of the family Cerambycidæ to standing timber injured by fire, $2,000,000 ; to felled timber and saw logs by the same kind of insect, $2,000,000 ; by other wood-infesting insects to standing and felled timber, $2,000,000 ; by foilage-infesting insects to living forest and shade trees, $3,000,000 ; by the white pine weevil, plant lice, scale insects, etc., to young forest growth, $1,000,000 ; by the powder-post beetles (Ptindæ) to forest products, such as seasoned handles, spokes, hoop-poles, building material, etc., $100,000, and by miscellaneous insects not included in the above estimates, $3,000,000—a total of $25,000,000 direct annual loss from insect ravages, which is without doubt a low estimate.

To the above could be added the loss to manufacturers in manufacturing and disposing of defective material, to consumers from the use of the same, and to the indirect loss to the country in the diminished forest area due to insect ravages ; all of which, could it be estimated in dollars and cents, would doubtless equal at least ten per cent. of the total value of the annual forest products of wood material in this country, or about $100,000,000 annually.

With Further Knowledge on the Subject Much of the Loss can be Prevented.

Probably one of the principal reasons why the economic study of forest insects has been neglected in this country is the prevalent belief that few, if any, practical methods can be found to prevent loss from their injuries. It is true the methods used to prevent loss from the attack of farm, garden, and fruit insects can not, as a rule, be successfully used against those affecting forest growth ; neither can many of the successful European methods of combating forest insects be adopted in this country. But there are simple, practical methods known which, if better understood by forest owners and manufacturers of forest products and properly applied by them, would prevent the annual loss of many millions of dollars' worth of timber.

Some of the results recently obtained and facts determined in the investigations now in progress in West Virginia in reference to the proper time to fell timber to prevent detrimental injury by insects, the utilization of defective material to the best advantage, and the introduction of predaceous and parasitic insects to prevent the undue increase of destructive species lead us to believe that many of the more serious troubles can be easily controlled when we learn more of the habits of the insects and the various conditions, favorable and unfavorable, for their development.

Additional Knowledge and More Special, Original Work Necessary.

Further original research and additional published knowledge are sadly needed in this branch of economic entomology. As compared with the knowledge of insects affecting other economic plants, scarcely anything is known of the life history and habits of even our commonest forest-tree insects. Consequently, the field for original work in forestry entomology is a broad one, rich in interesting material as well as in possibilities of important discoveries.

One of the most important aids toward advancement would be, in our opinion, carefully prepared monographs of the insects known to infest the different economic forest trees, on a similar plan to that adopted by Professor Forbes in his recently issued part of "A Monograph of insects injurious to Indian Corn."

Previous to the undertaking of work of this kind, however, further knowledge is necessary in reference to the food habits of the insects found upon or within the different host plants, and whether they are destructive, detrimental, beneficial, or neutral in their

economic relation to the host. This important information can be best and most reliably supplied by specialists who are studying the different families of insects, and by those who will make a study of the food habits and life history of certain classes of insects which infest forest growth, such as foliage-infesting, bark-infesting, and wood-infesting insects, etc., as special lines of research.

If specialists in these various lines will keep in mind the importance of noting the host relations of the species they collect or observe on forest growth, and will publish the knowledge thus obtained, together with lists of species taken on the various economic forest trees, they will contribute valuable service to the country in the rapid advancement of forestry entomology.

Mr. Webster read the following paper:

THE IMPORTATION AND REPRESSION OF DESTRUCTIVE INSECTS.

By F. M. Webster, Wooster, Ohio.

In the year 1795 my topic would have sounded remarkably visionary and illogical; not that it was not known that destructive insects were being brought into this country from England and Europe, but that there should be any united action to prevent such importations, or to suppress them after being introduced, would heve sounded unreasonable and unpractical. But, come to think of it, can we name a single imported insect that has been repressed, or, in fact, has been seriously impeded in its diffusion over the country, by any systematic obstacles placed in its way by the action of man? Is it not nearer the truth to say that we have, as a people, assisted this sort of immigrants, both in reaching this country and in getting inland as fast as possible after they had landed? Our entomologists have increased in numbers and efficiency to deal with these pests, but I do not know of a single one that we have prevented from coming to this country or stamped out after it had reached here.* That we have and are saving the country millions of dollars annually by our advice and experiments I freely admit, but that is only a temporary relief, and by no means a protection against future depredations and losses. Now, there must be something the matter somewhere, and if not with the entomologists, as I feel that it certainly is not, then wherein lies the obstacle? Entomologists do not make the laws, nor are we always able to get those properly enforced that we do have; but that does not settle the problem. For my own part, I have very little faith in State laws, even if they could be enacted, and have often asked myself the question whether or not it was possible for a republican government, composed of minor governments, possibly, as in our case, numbering nearly half a hundred to protect its people from the immense losses occasioned yearly by destructive insects whose place of nativity is known to be thousands of miles away and across wide stretches of ocean which they could never have crossed unaided.

At present we seem unable to deal with the problem intelligently and practically, even within our own borders. We can not, as a people, protect ourselves from each other, much less from countries who very naturally have less regard for us than we have for ourselves. It was with such feelings that I watched the diffusion of the San Jose scale, even after it had been located. Here was a simple problem in national economic entomology, and the question appeared to me to be composed of two propositions, viz: Could we do anything with it? and if so, what would be the importance of the entomologist in this transaction? We have been steadily gaining strength during the last quarter of a century, and I was a little desirous of seeing how powerful we were getting to be, how much we could do to stop the spread of this pest, as well as to effect its extermination where it had already gained a foot-hold. True, we had no laws to sustain us; but if we could but show the necessity for them we would have accomplished much, for, while

*See appended note at the end of this paper.

the San José scale is the latest importation, it by no means follows that it will be the last. It is all right to study the biology of the insect, and this is really the first step to be taken, but the duty of the economic entomologist does not stop there by any means. The man who has been unfortunate enough to get the thing in his orchard wants to know all he can learn about it, but the one who is free of it would vastly more like to know how to keep free of it. Some of you are aware that I am not in the least in sympathy with the manner in which we have been dealing with this pest, or rather with those who have knowingly carelessly harbored it. I do not say this with a spirit of fault finding or criticism, but rather with the idea of improving upon the policy. I fully submit that it is not right to knowingly wreck the business of any nurseryman who is willing to do everything in his power to prevent distributing such a pest with his stock ; but it seems to me that we commit even a greater mistake and do a more unjust act when we say that such a pest is in a certain locality, thereby throwing the onus on both the innocent and the guilty. This appears to me to be the very worst sort of an injustice, and places a premium on dishonesty. We should either give the name of the proprietor or else make no public statement whatever, giving him notice that any attempt to send out infested trees or plants will result in a prompt exposure and public condemnation.

If I were to say that a member of this association was a murderer, it would reflect on the honour of all of us, and would serve to protect the guilty one from justice, provided there was such a one among us. Hereafter when we have to quarantine, let it be against individuals or firms and not against States or portions of States in which the innocent outnumber the guilty. We must use harsh and severe measures where such are necessary in order to be just to the deserving, but we have no right to make these deserving ones a partner in dishonesty with the unworthy and disreputable. To do this is but to place ourselves in a position where we are sure to be imposed upon by the latter and secure the merited distrust of the former. The people are coming to place some of their interests in our keeping, and if we would hold on to that confidence we must deal justly but firmly with those who threaten such interests, with the sole aim of profiting thereby. Even if entomologists were clothed with the right to enter into an agreement with nurserymen to keep the presence of a dangerous pest a secret from the public, which I strongly question, it is poor policy to do so. For a public servant to make private arrangements with those harboring public enemies is, generally speaking, a risky business and not usually conductive in elevation to the estimation of those whose esteem we can not well afford to ignore. There should be a discrimination between the deserving and the undeserving, but it should be extended and not promised, and even then with the understanding that it was entirely in the way of official assistance. If we follow the proper course, so as to merit the confidence of the people, the latter will be perfectly satisfied with the information that infected nurseries are under strict surveillance, and nothing infected will be allowed to go out ; but let there be a few more revelations of the actions of some of these, such as we have seen within the last year, and people will naturally begin to speculate as to whom we are assisting and whose interests we are protecting.

I mention these things because I believe we can improve upon the policy that some of us have been following, largely by force of circumstances. What I would urge is this: First, a uniform policy to be followed as closely as our surroundings render possible by all of us ; second, on the information of an infested nursery coming to us the proprietors are to be informed that no infested stock is to be sent out, and that they are to promptly go to work to stamp out the pest, and that any attempt to evade these rules will result in a prompt exposure. If it is known that their trade will not suffer if they choose to purchase their stock from uninfested localities until they have destroyed the pest on their own, most men will see at once that it is the least expensive way out of the trouble. I am satisfied that there is a method of procedure that will work the least hardship to the deserving, yet will compel the stubborn to keep infection confined to their own premises and stamp it out there as soon as possible. I believe that we hold the balance of power, so to speak, and need not barter our influence, but hold it to be sought for by those who wish to escape with the least trouble and loss If we are but just in our actions there will no trouble about the better class of nurseymen siding with us, and we

shall have no difficulty in indicating the dividing line that separates the honorable from the dishonorable, and it will avail nothing for a belligerent firm to close their grounds and books against inspection and then demand our proof of infection. The very lack of proof of non-infection will be sufficient to fasten suspicion upon them.

I have noticed that the services of entomologists have been quite in demand during the last year by nurseymen who were free of the San Jose scale, and the statements of such entomologists were used in the advertisements of these firms; and I think the influence of Dr. Lintner and myself has been felt by at least two nursery firms when it came to the question as to whether they could continue to impose on the public or not. Now, while, as I stated, we have no laws to sustain us, we have a strong public sentiment in our favour, quite sufficient to influence the honorable to favour our plans, and the others we can whip into line, so to speak, by working on their interests. While we have not come out of this contest just in the shape that I wish we had, we have certainly placed our profession on a better footing and shown that we have a power to do for right and justice; that we can help the deserving and at the same time deal firmly and judiciously with the undeserving and disreputable; and so long as we are faithful to our trust we shall be able not only to hold our influence but greatly increase the same.

I confidently look for considerable aid from nurseymen themselves in the matter of preventing the distributing of orchard pests. The most pushing and energetic are beginning to see that it will pay to spray their trees year after year in the nursery row with both insecticides and fungicides; that by so doing they will get a better growth and consequently a larger number of first-class trees that will bring a better return for use of their land and labour. Now, these are not likely to be so blind as not to see that to be able to warrant their stock free from insect and fungus enemies will give them a prestige, and they will thus guarantee every bundle of stock that is shipped from their grounds. When we reach this stage of advancement it will be a small matter to get a United States law that will make this a condition of acceptance for transportation by the railway and express companies.

In the past our advice and cautions have been more or less ignored, but I think if a nurseryman were about to import trees or bring them from California he would think of consulting the United States entomologist in regard to the risk he would run with respect to injurious insects. And there is little doubt that there will be much more caution exercised in future than there has been in the past, and the next new thing we get we shall be better prepared to exert our power and influence than we were in this case. I am satisfied that the San Jose scale can be stamped out where it has been introduced, at least between the Rocky and Alleghany mountains. East of this area it will have to be exterminated or else many nurseries will be compelled to suspend business for lack of customers, and they are not going to do this in the near future. We have done well this time, but we will do better in the future.

Note.—The fluted scale of the orange (*Icerya purchasi*), though it has been subjugated in California, at a saving of thousands, if not, indeed, millions, of dollars (and the importation of the natural enemies whereby this was accomplished was the greatest achievement ever attained in practical entomology), still it has yet to be exterminated. So of the gypsy moth (*Ocneria dispar*), introduced into Massachusetts by a lamentable piece of carelessness on the part of an entomologist many years ago, while it has been overcome in some localities, it has not been exterminated. I am free to confess that up to the time of presenting this paper I had very serious doubts as to the possibility of this ever being done; not because of any fault or neglect among those intrusted with the work, but because it appeared to me that they had attempted an impossibility. I have since spent a day in examining the work in all of its details, and believe that I saw not only what had been done, but also what yet remained to be accomplished; and that, too, with unprejudiced eyes and mind, and in company with one who clearly had no other motive than to show me every feature precisely as it existed, without magnifying, minifying or concealing anything. I now feel confident that the question of the extermination of this

pest in Massachusetts is simply one dependent upon the support in future given those in charge of the work; that with proper support financially this pest will be absolutely wiped out of existence in America, and that the achievement will be the greatest yet attained, and one of which we shall all feel proud, while it will redound to the credit of economic entomology all over the civilized world.

F. M. W.

Mr. Fernald asked if anyone was aware of wilful and malicious importations of injurious insects from Europe, referring in this connection to the report of the possible transportation of certain American insect pests in the opposite direction. He was himself aware of no such cases.

Mr. Smith said the only case known to him was the importation of the Ailanthus silkworm.

Mr. Sirrine, referring to Mr. Webster's communication, said that he had found about the 1st of July instances of the purchase of apple trees badly infested with living San Jose scale, which had supposedly been effectually treated before being sold and sent out.

Mr. Smith said that he was aware that these trees had been treated with gas during the winter, and described the methods which had been followed. In the examination made by himself he had found no living scales, but undoubtedly some living specimens had been left, and probably from these the trees had become re-stocked. He pointed out the necessity of examining every scale before it was possible safely to pronounce stock immune, and therefore the impracticability of giving any such indorsement to nurseries.

Mr. Riley emphasized the extreme difficulty and great liability to error on the part of entomologists should they follow the plan of pronouncing any particular nursery free from scale. In some cases circumstances may warrant such an indorsement, especially if there is reason to believe that the insect in question is recently introduced and therefore confined to a restricted area or single point of infestation, as seemed, indeed, to be the case in the first discovery of the San Jose scale in the east. In such cases it may not be necessary to give publicity to the point of infestation if proper measures are being taken to suppress the insect. It was on this basis that he acted in the case of the San Jose scale; but when an insect is known to be widely disseminated a full public statement of the extent of the infested locality is desirable.

Mr. Smith agreed with Mr. Riley as to the difficulty of pronouncing any nursery untainted, and had decided for himself not to give clean bills of health to any nurseries in future.

Mr. Southwick read a paper entitled "Economic Entonomological Work in the Parks of New York City."

Mr. Webster read a paper on the "Insects of the year in Ohio." The time available for the reading of papers having expired, the three following, whose authors were absent, were read by title only, viz.:—"On the Natural Conditions which Affect the Distribution and Abundance of Coccidæ," by T. D. A. Cockerell, Las Cruces, N. Mex.; "How shall we Improve our Collections?" by C. P. Gillette, Fort Collins, Colorado; and "Carbon Bi-sulphide for Crayfish," by H. E. Weed, Agricultural College, Miss.

The following resolution relative to the Gypsy Moth Commission, introduced by Mr. Howard, was now brought up and received the unanimous indorsement of the Association:

Resolved, That it is the sense of this Association that the present Gypsy Moth Commission is prosecuting its work in the most intelligent and praiseworthy manner, and that its hands should be upheld by the State authorities.

Mr. Lintner presented the following resolution, which was also unanimously adopted:

Resolved, That this Association has learned with deep regret of the intended discontinuance of *Insect Life* with the present number. In consideration of the unusual value of this publication, the eminent ability with which it has been conducted, the high appreciation in which it has been held by all of our entomologists and those in other countries, and the importance of the published investigations into the life history of insects, largely on their economic aspect, this Association earnestly requests of the Department of Agriculture that the resumption of the publication of this invaluable publication may be directed at no distant day.

The Committee on Nominations, consisting of Messrs. Lintner, Davis and Rolfs, proposed :

For *President*, C. H. FERNALD, of Amherst, Mass.
For *First Vice-President*, F. M. WEBSTER, of Wooster, Ohio.
For *Second Vice-President*, HERBERT OSBORN, of Ames, Iowa.
For *Secretary*, C. L. MARLATT, of Washington, D. C.

On motion, the chair was instructed to cast the ballot of the Association for the gentlemen named, and they were declared duly elected.

On motion of Mr. Southwick, the reading of the minutes of the entire meeting was dispensed with, and on motion of the same gentleman a vote of thanks was tendered the President and Secretary of the Association in recognition of their services.

On motion of Mr. Howard, the local committee in charge of the meeting at Springfield was given a vote of thanks.

President-elect Fernald took the chair and briefly expressed his thanks for the honour conferred upon him.

The Association then adjourned.

WILLIAM H. EDWARDS.

Our readers will all, we are sure, be glad to receive the excellent portrait prefixed to this volume of the well-known and now venerable entomologist, Mr. W. H. EDWARDS, of Coalburgh, West Virginia. His life-long work has been the study of diurnal lepidoptera, and the results of that work are splendidly set forth in the beautifully illustrated volumes of his "Butterflies of North America." In April, 1868, the first part was issued, and at once commended itself to entomologists everywhere by the exquisite beauty and finish of the plates and their faithfulness to nature. In July, 1872, the first series, forming a large quarto volume with fifty plates, was completed. The second series, containing fifty-one plates, was begun in May, 1874, but not finished until November, 1884; the less frequent issue of the parts being more than compensated for by the increased value of both plates and letter press. When the work was begun, as Mr. Edwards stated in his preface, little or nothing was known of the eggs, larvæ, or chrysalids of any except the commonest butterflies, and accordingly his first volume illustrated only the perfect state. In 1870 he made the notable discovery that eggs could be satisfactorily obtained by confining the female butterfly of any species with the growing food-plant of its larva, and at once began the study of the life-histories of a number of species previously known only in the imago state. The results of these studies are admirably set forth in the letter press as well as in the plates of the second and third series; on these are accurately depicted eggs and larvæ in their different stages, as well as chrysalids and imagoes. Many wonderful discoveries have been made during these investigations, among the first being that of the seasonal trimorphism of *Papilio Ajax* and the dimorphism of *Grapta interrogationis* and of *G. comma*. The process of breeding was soon taken up by Mr. Edwards's friends and correspondents all over North America, and, aided by the general extension of railways over the continent, he was able to get eggs of butterflies from widely distant localities, and to follow them successfully through all their stages. Thanks to his efforts the reproach of ignorance of the preparatory states of our butterflies has been removed, and though much remains to be learnt, vast progress has already been made. The first part of the third series was issued in December, 1886, and in October last we had the pleasure of welcoming the sixteenth. Far from showing any decline from the author's high standard of excellence, this last issue may justly be regarded as the climax of good work, both on the part of the writer and the artist. All through Mr. Edwards has been fortunate in having his wishes so ably carried out by his artist-assistants—Mrs. Mary Peart, of Philadelphia, who has drawn most accurately nearly all the plates, and in order to do so satisfactorily has reared most of the caterpillars; and Mrs. Lydia Bowen who has so exquisitely performed the work of colouring. Many of the plates of the third series have been drawn by Mr. Edward A. Kellner, of Philadelphia.

In addition to the great work that we have just referred to, Mr. Edwards has contributed largely to the periodical literature of the science, especially to the proceedings and transactions of the American Entomological Society and to the *Canadian Entomologist.* His first contribution to its pages was published in the third number of the first volume, in 1868, and he has continued to favour it with articles of great value ever since, his last paper, in the September number of volume xxvii., being the one hundred and sixty-eighth which he has written for our journal.

Mr. Edwards was born on the 15th of March, 1822, and will soon complete his seventy-fourth year. That he may long be spared in health and prosperity to carry on his excellent work is the cordial wish of the writer and all his friends.—C. J. S. B.

BOOK NOTICES.

The Butterflies of North America, with coloured drawings and descriptions, by W. H. Edwards. Third series, part xvi. Houghton, Mifflin & Co., The Riverside Press, Cambridge, Mass.

Though nearly a twelvemonth has gone by since the preceding part was issued, we could well afford to wait with patience for another number, when our author rewards us with so much that is remarkably interesting as well as valuable regarding the life-histories of some hitherto little known butterflies.

The first plate, which as usual is exquisitely drawn and coloured, depicts the female of *Parnassius smintheus*, Doubl.Hew., and both sexes of the variety *Hermodur*, H. F. Edw., together with the egg, larva in all its stages, chrysalis, last segments of the male butterfly, and many highly magnified details. After giving a description of the various stages of the insect, the author relates many most interesting facts regarding the life and habits of the butterfly, which have taken expert observers in the States of Colorado, Montana and Washington no less than twenty years to accumulate! The account is concluded with a description of the formation of the extraordinary pouch or keel which is to be seen beneath the abdomen of the females of various species of Parnassius. That this should be formed by the male is one of those strange marvels that render the careful study of the lives of our butterflies so interesting and attractive.

The second plate depicts both sexes of *Satyrus Charon* and the male of its variety *Silvestris;* also the egg, the various stages of the larva, the chrysalis, and many details. The imago and the several preparatory stages are described, and a short but interesting account is given of the habits of the butterfly and the rearing of the larvæ.

On the remaining plate are figured the egg, three stages of the larva with details, and both sexes of the imago of the British Columbian species (*Chionobas gigas*), Butler. After describing the preparatory stages so far as known, the author relates the differences in appearance and habitat between this species and *Californica* and *Iduna,* which are frequently confused in collections. *Gigas* is shown to be confined, so far as is yet known, to Vancouver Island, where the male frequents the tops of the highest mountains, the female being usually found much lower down ; *Iduna* inhabits the slopes of the evergreen red-wood forest in north-eastern California on the Pacific coast ; and *Californica*, the hot arid regions of east Oregon, Washington and the semi-desert portion of north-east California. "*Gigas* is semi-Arctic, living amid the cold, dark fir forest ; *Iduna* is temperate, living in the mild, dark red-wood forest ; *Californica* is semi-tropical, living in open, dry, warm glades in the "bushland" on the border between the forest and the open plains. *Gigas* alights on bare rocks ; *Iduna* on green twigs ; *Californica* on dead or dry grass." But we must refer the reader to the book itself for all the interesting particulars regarding these strange butterflies.

The wonder to us is that so few entomologists subscribe to this magnificent work. The parts are issued at such long intervals that the cost is very light ; those who have secured them know what a treasure they possess and how highly they prize it.—C. J. S B.

The Natural History of Aquatic Insects, by Prof. L. C. Miall, F. R. S. London and New York, MacMillan & Co. (66 Fifth avenue, N. Y.; price, $1.75), pp. 595.

This interesting work is intended, as the author states, "to help those naturalists who take delight in observing the structure and habits of living animals," and also to revive an interest in the writings of some of the old zoologists who did notable work in their day, but who are now almost forgotten, namely, Lyonnet, Réaumur, Swammerdam and De Geer, of whose lives and work he gives a short account.

To any lover of nature who wishes to look into the lives and doings of living creatures, and to investigate their structure and appliances for carrying on the business of their lives, this book will prove a very great help as well as an unfailing pleasure, and it ought to lead many a reader to explore for himself the ponds and pools in his own neighborhood which teem with insect life. The different groups of insects that live in the water in their larval or perfect states, are treated of in turn—water beetles and the larvæ of many flies, the caterpillars of some moths, caddis worms, May flies, alder flies (Sialidæ), stone flies (Perlidæ), dragon flies, pond skaters, water boatmen, etc. The very names of these insects bring to mind what one cannot fail to have seen and watched and wondered over. To have many of these wonders explained and described, and to have the insects themselves depicted and the peculiarities of their structure made clear by excellent woodcuts, is what we owe to the author of this book, and we hope that many will turn to its pages with profit and delight. It is a handsome volume, with clear, large type and a number of very good illustrations.—C. J. S. B.

The Cambridge Natural History, Vol. V. Peripatus, by Adam Sedgwick, M.A., F. R.S.C.; Myriapods, by F. G. Sinclair, M.A.; Insects, (Part 1) by David Sharp, M.A., F.R.S. London and New York, MacMillan & Co.

The possession of some such work as this is of primary importance to the student in any department of zoology, to enable him to obtain, and have at hand for reference, a general knowledge of the varied groups into which, for convenience of study and classification, the animal kingdom is divided. In every home that can afford the luxury of books it will also be found most valuable, affording a continual fund of instruction, and implanting in the children a spirit of inquiry, and of interest in the many wonders of nature. It is only about ten years since the publication, in six sumptuous quarto volumes, of the Standard Natural History, edited by Prof. Kingsley, and having as contributors many of the most eminent scientific men of America. To a certain extent their references and illustrations were more largely drawn from the fauna of our own continent, although a work of this general character must not be expected to be in any way restricted in its choice of examples of any group. Our knowledge of the animal kingdom is, however, so constantly being enlarged by the labours of an ever increasing and better equipped body of investigators, that the present work will be found to be considerably in advance of any previous publication. The editors are S. F. Harmer, M.A., Superintendent of the Cambridge University Museum of Zoology, and A. E. Shipley, M.A., University lecturer on the Morphology of Invertebrates. These names, and those of the authors of the various memoirs, are a guarantee as to the accuracy and completeness of the work, and of its fitness either for the private student or for the teacher of zoology. When finished it will consist of ten handsome large octavo volumes, which will form a desirable addition to any library.

Mr. Sedgwick's memoir on Peripatus indicates at once the marked advance that has been made in some directions of biological research. In the Standard Natural History, where it is placed as a sub-class—Malacopoda—of the insects, this curious genus occupies scarcely more than a page, for the knowledge of it was than very fragmentary. Mr. Sedgwick, whose studies of the genus have been very extended, and who has written previous monographs, gives a very interesting account not only of the outward appearance of this very peculiar creature, but also of its embryology, development and habits. There are numerous illustrations and a map showing the distribution, which extends through portions of South Africa, Australia, New Zealand, South and Central America and the West

Indies. Described by its discoverer, (Rev. L. Guilding), as a mollusc, from its slug-like form, this unique animal is now found to belong to the arthropods, although possessing features not belonging to other members of that division. Indeed it is said to "stand absolutely alone as a kind of half-way animal between the Arthropoda and the Annelida." As a very primitive type, exhibiting affinities to both groups, it possesses a special interest to zoologists. The species are few in number, and are of elongated slug-like shape, with from seventeen to thirty-four pairs of legs; subsisting upon animal food and shunning the light.

The Myriapoda are stated by Mr. Sinclair in his introduction, "not to have attracted much notice until comparatively recent times. Compared with insects they have been but little known. The reason of this is not hard to find. The Myriapods do not exercise so much direct influence on human affairs as do some other classes of animals; for instance, insects. They include no species which is of direct use to man, like the silk-worm or the cochineal insect, and they are of no use to him as food." To the farmer's crops, however, some species, known as wire-worms, (Iulus) do considerable damage, while many of the carnivorous species must, on the other hand, be of considerable assistance in destroying injurious insects. Myriapods are those elongate, many-footed creatures, lurking under rubbish and in dark places, which are usually called centipedes and millepedes Regarded with distrust on account of the venomous bite of some of the large tropical species, their appearance and habits of concealment produce in most people a decided aversion to more intimate acquaintance. The author, however, gives a very pleasing summary of their habits, and proves that a study of these creatures, as is true of all forms of life, however repellant to the ordinary observer, is far from being devoid of interest. Our popular names are not sustained on closer examination, for none of the species have nearly a thousand legs, and a large proportion have far less than one hundred. The number varies from nine pairs in the tiny Pauropus, to about one hundred and seventy pairs in some species of Notophilus. The Myriapods have many affinities to the insects, and have been classed with them by many authors. They differ from insects, as well as from the other classes of arthropods, in having true, jointed legs on the posterior segments of the body. Mr. Sinclair recognizes five orders, the species of which vary in length from the one twenty-fifth of an inch (Pauropus) to almost a foot, as in the tropical centipedes. He does not mention, however, perhaps because it is now extinct, the great centipede, described in the Japanese tale of My Lord Bag-of-Rice, which inhabited Mukade-yama (Centipede Mountain) on the shores of Lake Biwa, and which was over a mile long, with exactly one thousand feet on each side of its body. Some of the forms, as Glomeris, are quite short and stout; others, as Iulus, have long cylindrical bodies; while Notophilus and Geophilus have the body very thin and elongated.

Eighty pages are occupied by these interesting memoirs on Peripatus and the Myriapoda, and in the third chapter Dr. Sharp introduces the Insects, and continues their discussion throughout the remaining five hundred pages, in a style that proves him a master of the subject, and also of its presentation to his readers. Naturally, as an Entomological Society, we take a closer interest in this great class, into which are grouped an immense assemblage of small creatures, varying to a wonderful degree in structure and habits, yet having, amidst all this diversity, well-marked relations to one another. To use the author's opening words "Insects form by far the larger part of the land animals of the world; they outnumber in species all the other terrestrial animals together, while compared with the vertebrates, their numbers are simply enormous. * * * * The largest insects scarcely exceed in bulk a mouse or a wren, while the smallest are almost or quite imperceptible to the naked eye, and yet the larger part of the animal matter existing on the lands of the globe is in all probability locked up in the forms of insects. Taken as a whole they are the most successful of all the forms of terrestrial animals. In the waters of the globe the predominance of insect life disappears. In the smaller collections of water many insects find a home during a portion of their lives, and some few contrive to pass their whole existence in such places; but of larger bodies of water they invade merely the fringes, and they make only the feeblest attempt at existence in the ocean."

A not infrequent question is "What is an Insect?" and for the benefit of many who have not opportunity to study entomology, yet to whom some knowledge of the subject is important, it may be answered by the author's brief and clear definition of the class Insecta; or Insecta Hexapoda.

"Insects are small animals, having the body divided into three regions placed in longitudinal succession, head, thorax and abdomen: they take in air by means of tracheæ, a system of tubes distributed throughout the body, and opening externally by means of orifices placed at the sides of the body. They have six legs and a pair of antennæ; these latter are placed on the head, while the legs are attached to the thorax, or second of the three great body divisions; the abdomen has no true legs, but not infrequently has terminal appendages and, on the under surface, protuberances which serve as feet. Very frequently there are two pairs of wings, sometimes only one pair, in other cases none; the wings are always placed on the thorax. Insects are transversely segmented—that is to say, the body has the form of a succession of rings; but this condition is in many cases obscure; the number of these rings rarely, if ever, exceeds thirteen in addition to the head and to a terminal piece that sometimes exists. Insects usually change much in appearance in the course of their growth, the annulose or ringed condition being most evident in the early part of the individual's life. The legs are usually elongate and apparently jointed, but in the immature condition may be altogether absent, or very short; in the latter case the jointing is obscure. The number of jointed legs is always six."

The amplification of this definition and the exposition of the external and internal structure, and of the functions of the various organs, occupy two chapters. Referring to Parthenogenesis, or "the production of young without the concurrence of the male," which sometimes occurs, the remarkable fact is noted that in a few species of saw-flies, gall-flies and scale-insects no male is known, so that they must be considered as perpetually parthenogenetic. The next chapter gives a valuable summary of the embryology and metamorphoses. While the vast majority of insects are oviparous, the eggs deposited varying greatly in number, size and shape, a few species bring forth living young, as in the Aphididæ (green-fly or plant-lice), which thus multiply with extraordinary rapidity. A brief chapter follows on the classification, and it can readily be understood that diversity of opinion has existed, and may long continue, as to the most satisfactory arrangement of the vast hosts of insects. As some 250,000 species have already been described, and several times that number undoubtedly exist, any scheme of classification must, under our present knowledge, fail to adequately provide for the reception of every form. Dr. Sharp points out that owing to the present limited knowledge of the earlier stages of insects, the only complete system of classification yet possible must be based upon the structure of the adult forms. It is noted with pleasure that he does not consider it necessary to make so many orders or primary divisions as has been the tendency of recent authors. Instead of twenty, as recently proposed by Packard, he limits them, much to the advantage of the ordinary student, to nine, viz., Aptera, Orthoptera, Neuroptera, Hymenoptera, Coleoptera, Lepidoptera, Diptera, Thysanoptera, and Hemiptera.

The Aptera are designated as "small insects, with weak outer skin, destitute throughout life of wings or their rudiments, but with three pairs of legs; antennæ large or moderate in size." It is pointed out however that this definition does not clearly differentiate them from many of the young individuals of other orders, and that the order does not, as its name might indicate, include all wingless insects. Two sub-orders are present: Thysanura, with the abdomen composed of ten segments, and Collembola, of not more than six. The study of these insects is attended with more than ordinary difficulty, as their habits and fragile structure make them troublesome to collect and preserve. Campodea, supposed by many authors to represent one of the most primitive types of insect, and therefore of unusual interest, is said to be "so extremely delicate that it is difficult to pick it up, even with a camel's hair brush, without breaking it." The Collembola are the "Spring-tails," two of the three families having the abdomen provided with a leaping apparatus which enables them to jump about in a very vigorous

and erratic way. The Aptera are supposed to feed upon vegetable and animal refuse, and can endure both heat and cold, but require moisture, so that they occur most abundantly in cellars, under rubbish, in mosses, and other damp situations.

The Orthoptera form one of the most important orders of insects, both as regards the diversity of structure exhibited, the great size of many species, and the enormous devastation often wrought by their innumerable swarms. Dr. Sharp occupies nearly one hundred and fifty pages with his synopsis of the order, and his admirably written and illustrated account of the various groups should awaken, in all who are fortunate enough to read it, a lively interest in the insect world. He estimates that the order contains, at the lowest figure, 10,000 species, and treats it as composed of eight families. Of these the first is the Forficulidæ, or earwigs; elongate insects, having the abdomen terminated by a pair of clasper-like instruments, often greatly developed. Many of the forms are wingless, and those provided with wings are able to completely fold them up and tuck them under short wing covers, so that they have considerable resemblance to some beetles of the family Staphylinidæ. In Canada earwigs are poorly represented, and the one little species of Labia found in Ontario is but rarely met with. The family Hemimeridæ contains a few small, wingless, blind insects from equatorial Africa, interesting as occurring on small mammals either as parasites or commensals. The Blattidæ, or cockroaches, are both destructive and unpleasant creatures, although some forms are brightly coloured. Canada is not much troubled with these creatures, although a few disagreeable species have been introduced, but in warmer climates they are often veritable plagues. The Mantidæ, or praying insects, are wanting in our fauna, but in tropical and sub-tropical regions the species are numerous and their bodies are often strangely developed; sometimes by leaf-like expansions, serving to make them inconspicuous among the foliage in which they lurk. These developments of structure are even more marked in the Phasmidæ—stick and leaf insects—as shown by the figures of various genera.

The family Acridiidæ contains those very prolific and voracious vegetarians, the locusts and grasshoppers. These breed so rapidly and appear in such enormous swarms as to make less incredible, than it might at first appear, the author's statement, previously quoted, as to the relative bulk of insects and other terrestrial animals. The migratory locusts at times destroy all vegetation over large areas, and may thus produce famine and disease. As Dr. Sharp says, "It is difficult for those who have not witnessed a serious invasion to realize the magnitude of the event. Large swarms consist of an almost incalculable number of individuals. A writer in *Nature* states that a flight of locusts that passed over the Red Sea in November, 1889, was 2,000 square miles in extent, and he estimates its weight at 42,850 millions of tons, each locust weighing one-sixteenth of an ounce. A second similar, perhaps even larger, flight was seen passing in the same direction the next day." The Locustidæ, or green grasshoppers, are more arboreal in their habits, and often have the wings of a very leaf-like appearance. They are also more musical, and capable of strong and sustained performances. The well known American Katydids belong to this family. The last family, Gryllidæ, contains the crickets, whose concerts enliven the summer evenings. The fossorial, or mole crickets, have the front legs most admirably adapted for burrowing.

The treatment of the Neuroptera occupies an equal space and is no less interesting. The first family, Mallophaga, contains the biting or bird lice, so troublesome to birds and mammals. The Termitidæ, or white ants, are one of the most wonderful of all the groups of insects, and the individuals are strangely modified to fit them for their duties in the communities of which they are members. A table is given which shows that as many as fifteen distinct forms may occur (as in *Termes lucifugus*), and many of these may co-exist in the community, while others are only produced as necessity demands. The African species are the most remarkable, *T. bellicosus* forming solid mounds as much as twenty feet high. To sustain the population of these immense colonies, the queen becomes a marvellous egg-producing machine. "Twenty or thirty thousand times the bulk of a labourer," she is unceasingly fed by a band of workers, and as unceasingly gives forth eggs, to the number even of "eighty thousand and upward in one day of twenty-four

hours." To the Neuroptera belong also the ant-lions, dragon flies and other well known insects. A large proportion are aquatic in their earlier stages, and most interesting in their habits, either as residents of the water or the air.

The last one hundred pages of Dr. Sharp's charming portrayal of the insect world is devoted to a portion of the Hymenoptera, the species of which are estimated at 250,000. This order contains, among its almost inexhaustible forms, those which are of exceptional interest, from the intelligence which governs their actions. Dr. Sharp has called attention to an error which has occurred through hasty writing of the explanation of the anatomy of *Sphex chrysis* (page 490, Fig. 333), where the letter *f* is called a division of the metanotum, whereas it really belongs to the mesonotum. This error will be corrected in the portion dealing with the Aculeata. The present volume only treats of the Sessiliventres, those in which the abdomen is broadly and closely joined to the thorax, and the parasitic families of the Petiolata, in which the abdomen is attached by a petiole, or stalk, often remarkably slender and prolonged. The first division includes the sawflies, of which the caterpillar-like larvæ are so injurious to vegetation, and the horntails, whose larvæ bore in the trunks of trees. The parasitic families exhibit much more variety of structure, and the species, even in our northern fauna, are exceedingly numerous. They vary in size; some Pimplids measuring several inches from the head to the tip of the very long ovipositor, while among the Proctotrypids and Chalcids are forms almost invisible to the naked eye. Dr. Sharp clearly tabulates the conditions under which the early life of such parasites is passed.

"1. The egg may be laid outside a larva, and the embryonic and larval developments may both be passed on the exterior.

2. The egg may be laid and the embryonic development passed through, outside the host, but the parasite on hatching may enter the host, so that the post-embryonic development is passed in the lymph of the host.

3. The egg may be laid inside the host, both embryonic and post-embryonic developments being gone through in the fluids of the host.

4. The egg may be laid inside another egg, the embryonic and post-embryonic developments being passed therein."

A large section of the Cynipidæ are not parasitic, but subsist upon plant tissues, producing swellings and distortions, known as galls, in which the larvæ live and develop. Among the illustrations of the hymenoptera are excellent figures of four insects occurring in Ontario and other portions of Canada, viz., *Oryssus Sayi*, *Tremex Columba*, *Thalessa lunator* and *Pelecinus polyturator*, the last three being quite common insects. The illustrations throughout the volume, 371 in all, are both accurate and artistic, and many have been specially drawn for the work. The paper and press work are of the best, and the result is a very handsome volume. The appearance of the next volume, completing this most valuable and enjoyable account of the insects, will be eagerly awaited.

W. Hague Harrington.

Rambles in Alpine Valleys, by J. W. Tutt, F.E.S.; 208 pages, five plates London: Swan, Sonnenschien & Co.

The Editor of *The Entomologists' Record and Journal of Variation* has added another to his popular books on the beauties of nature. This time he takes the reader abroad to the lovely scenery of Switzerland on the Italian slopes of Mont Blanc, where he wanders for the most part out of the beaten track of the ordinary tourist. Much of the volume is filled with charming pen-pictures of the infinite variety of grandeur and beauty to be found among the lofty mountain tops, the towering crags, the densely wooded ravines and the dashing torrents of this secluded Alpine region. The eye of the naturalist does not fail to observe the marvellous variety of animal and vegetable life that is to be found in this limited area; and the author describes many a plant and flower, and especially the gay butterflies and pretty moths with which the region

abounds. Some of the most interesting passages are those that deal with the phenomena of variation caused by environment, the results of the glacial epoch in the distribution of species, the effect of altitude on plants and insects, the evolution of the genus *Colias*, the production of colours, the causes of hybernation, and other topics which arise from time to time as the author rambles through the valleys or climbs the Alpine hills. The perusal of such a book as this must help the reader to see and observe, and lead him on to think out for himself the causes and the objects of the life that everywhere surrounds him.—C. J. S. B.

A MANUAL FOR THE STUDY OF INSECTS, by John Henry Comstock and Anna Botsford Comstock; Ithaca, N.Y. Comstock Publishing Co., 1895.

This is a work of 700 pages, profusely illustrated. A table of the classes of the Arthropoda is given, followed by a short characterization of the Crustacea. Thirty-three pages are devoted to the Arachnida, and a table is given for separating the principal families of the Araneida. The Myriapoda are briefly referred to, and chapter iii. begins the discussion of the true insects (Hexapoda). Nineteen orders are recognized, and a careful table is given for their practical determination.

In the remainder of the work, 618 pp., the several orders are treated with tables carrying the student to the families, each illustrated by typical common species, of which brief accounts are given.

In the lepidoptera, diptera and hymenoptera, the uniform system of nomenclature of the wing veins discussed by Prof. Comstock in "Evolution and Taxonomy" is applied throughout the orders. As stated in the preface but slight changes are made from the usual classification of the families, except in the lepidoptera where the system proposed in "Evolution and Taxonomy" is adopted with slight changes. This is remarkably like Dr. T. A. Chapman's classification from pupal characters and the present writer's one on larval characters. All three agree in breaking up the old groups Zygænidæ and Bombyces, and the several members are referred to essentially the same places. The work affords for the first time a means for teacher as well as student to determine the family of any North American insect, for here synoptic tables replace the vague characterization so generally in vogue in zoology. To bring the tables down to species, as is done so satisfactorily in botany, as the author remarks, would make the work of enormous length, not to mention the fact that the present state of our knowledge of insects does not warrant such an undertaking. The work seems a very valuable and timely one.—Harrison G. Dyar.

We wish to add to the foregoing notice our hearty congratulations to Prof. Comstock and his talented wife upon the completion of their excellent work, and our tribute of praise for the thoroughly admirable manner in which they have performed it. It is now a little more than six years since we noticed in these pages the first part of this work, which consisted of 234 pages and 200 wood cuts; we then stated that "judging from the portion before us we have no hesitation in saying that the complete work will be a most valuable and admirable manual of entomology; in clearness and simplicity of style, in excellence of illustration and in arrangement of matter it leaves nothing to be desired." This prediction has been most completely fulfilled, the volume before us being, in several respects, even an improvement upon the original publication. The new illustrations are more artistic, and the diagrams of wing-venation and details are clear and accurate; the synoptic tables will afford any painstaking student satisfactory means of classifying into families any specimens that he collects, while the letter-press and figures will enable him to determine a large number of species. We heartily commend the work to all who are beginning to study entomology, and we can assure others, who have made some progress in the science, that they will find in it a vast deal of help and information that will prove of the utmost value. We may add that the illustrations consist of 800 wood cuts and six beautiful full-page plates, the one forming the frontispiece being coloured. The price of the work is so reasonable that it is within the reach of all.—C. J. S. B.

CANADIAN SPIDERS, by J. H. Emerton. Transactions of the Connecticut Academy, Vol. IX., July, 1894. Thirty pp., four plates.

This interesting and valuable paper treats of spiders collected in various parts of Canada from the Rocky Mountains to the Gulf of St. Lawrence. The author states at the outset that the species differ little from those of the New England States. "Out of sixty-one species, from Labrador to Manitoba, fifty six species live in New England; and twenty-seven out of forty-eight species from the Rocky Mountains. Of the latter no less than forty of the species mentioned were collected by Mr. Bean at Laggan, and of these sixteen are described as new to science. Mr. Tyrrell, of the Geological Survey of Canada, supplied other species from the Rocky Mountain Region, Alberta Territory and Ottawa, and other collectors from the various localities mentioned in the paper. The plates illustrating the new species are admirably drawn by the author, the excellence of whose work in scientific illustration has long been well known and highly appreciated.—C. J. S. B.

REPORT OF OBSERVATIONS OF INJURIOUS INSECTS AND COMMON FARM PESTS, DURING THE YEAR 1894, with Methods of Prevention and Remedy. Eighteenth Report. BY ELEANOR A. ORMEROD, F. R. Met. Soc. etc., etc., London; Simpkin, Marshall, Hamilton, Kent & Co., Limited, 1895, pp. 122, lxii, plate.

In this the author has given us another of her most excellent annual reports, if anything, better than those that have preceded it. There are twenty-nine species, besides the two groups, Iulidæ and Vespidæ, fully treated in the report which is illustrated by forty five figures and one excellent plate, the latter devoted to the Stem Eelworm, *Tylenchus devastatrix*, in connection with its recent discovery as injurious to hops. We congratulate the author on being able to give us so much information on Eelworms, Warble Fly and carabid enemies of the strawberry. In fact she has, throughout her report strictly adhered to the plan expressed in the preface, viz., "not to enter again on such of our common infestations as have been repeatedly noticed in my preceding reports, excepting where there was some new information to be given, or (sometimes) needed." This renders the report of unusual value. To do the publication justice is simply out of the question in an ordinary book notice, but suffice it to say that it is in every way a credit to its author.

The writer well remembers an evening spent with the late Frazer S. Crawford, at his suburban home near Adelaide, South Australia. We had been discussing entomology and entomologists, when he made a remark something like this. "Miss Ormerod is a noble woman and is giving both her life and her wealth to the agricultural interests of England, and I cannot understand why she should not be better appreciated by Englishmen." The sentiment will be echoed by American entomologists, but I fear in our hurry and bustle, we forget to drop an occasional word of encouragement and appreciation, such as we ourselves would gladly receive. Working almost alone, and comparatively unaided, in a labour of love not always appreciated, it seems to me that words of encouragement from her colleagues, both in America and out of it, are but matters of justice. Other reports on economic entomology there are, and they come officially from the Board of Agriculture of England, but the writer has searched through them in vain for tokens of originality or just credit for the information contained in them.—F. M. W.

OBITUARY.

CHARLES VALENTINE RILEY.*

The career of this distinguished naturalist, so suddenly closed while in good health, and with apparently many years of usefulness before him, was a remarkable one. Biologist, artist, editor and public official, the story of his struggles and successes, tinged as it is with romance, is one full of interest. Beginning life in America as a poor lad on an

*The following memoir of our lamented friend, Professor Riley, contributed to a recent number of "Science," by Professor A. S. Packard, is so excellent and complete that we prefer to give it in full rather than attempt to prepare another which would not be so satisfactory.—ED.

Illinois farm, he rose by his own exertions to distinction, and to become one of our most useful citizens in science, both pure and applied. His nature was a many-sided one, and his success in life was due to sheer will-power, unusual executive force, critical judgment, untiring industry, skill with pencil and pen, and a laudable ambition, united with an intense love of nature and of science for its own sake. This rare combination of varied qualities, of which he made the most, rendered him during the thirty years of his active life widely known as a public official, as a scientific investigator, while of economic entomologists he was *facile princeps.*

Charles Valentine Riley was born at Chelsea, London, September 18, 1843. His boyhood was spent at Walton-on-Thames, where he made the acquaintance of the late W. C. Hewitson, author of a work on butterflies, which undoubtedly developed his love for insects. At the age of eleven he went to school for three years at Dieppe, afterwards studying at Bonn-on-the Rhine. At both schools he carried off the first prizes for drawing, making finished sketches of butterflies, thus showing his early bent for natural history, and his teacher at Bonn urged him to study art at Paris. But it is said that family circumstances, though rather, perhaps, a restless disposition, led him to abandon the old country, and at the age of seventeen he had immigrated to Illinois, and settled on a farm about fifty miles from Chicago. When about twenty-one he removed to Chicago, where he became a reporter and editor of the entomological department of the *Prairie Farmer.*

Near the close of the war, in 1864, he enlisted as a private in the 134th Illinois regiment, serving for six months, when he returned to his editorial office.

He also enjoyed for several years the close friendship of B. D. Walsh, one of our most thorough and philosophic entomologists, with whom he edited the *American Entomologist.* His industry and versatility as well as his zeal as an entomologist, made him widely known and popular, and gave him such prestige that it resulted in his appointment in 1868 as State Entomologist of Missouri. From that time until 1877, when he left St. Louis to live in Washington, he issued a series of nine annual reports on injurious insects, which showed remarkable powers of observation both of structure and habits, great skill in drawing and especially ingenious and thoroughly practical devices and means of destroying the pests. The reports were models and will never become stale. Darwin wrote in 1871: "There is a vast number of facts and generalizations of value to me, and I am struck with admiration at your power of observation. The discussion on mimetic insects seems to me particularly good and original." In reviewing the ninth and last of these reports, published in 1876, the *Entomologists' Monthly Magazine* of London, remarked: "The author, in giving full scope to his keen powers of observation, minuteness of detail, and the skill with which he uses his pencil, and at the same time in showing a regard for that scientific accuracy—unfortunately too often neglected in works on economic natural history—maintains his right to be termed the foremost economic entomologist of the day." It goes without saying that this prestige existed to the end of his life, his practical applications of remedies and inventions of apparatus giving him a world wide reputation. In token of his suggestion of reviving the vines injured by the Phylloxera by the importation of the American stock, he received a gold medal from the French Government, and he afterwards received the cross of the Legion d'Honneur in connection with the exhibit of the U. S. Department of Agriculture at the Paris Exposition of 1880.

The widespread ravages of the Rocky Mountain locust from 1873 to 1877 had occasioned such immense losses in several States and Territories that national aid was invoked to avert the evil. The late Dr. F. V. Hayden, then in charge of the U. S. Geographical and Geological Survey of the Territories, with his characteristic energy and sagacity, initiated researches on the locust in the Territories. He sent Dr. P. R. Uhler to Colorado in the summer of 1875, and also attached the present writer to the Survey who spent over two months in entomological work in the same year in Colorado, Wyoming and Utah, publishing the results in Hayden's Ninth Report. Mr. Walsh had made important suggestions as to the birthplace and migrations of the insect. Meanwhile Riley had

since 1874 made very detailed studies on the migration and breeding habits and means of destruction of this locust (published in his Missouri State Report for 1876 and 1877). Dr. Cyrus Thomas had also been attached to Hayden's Survey, and published a monograph on the locust family, *Acrididæ.* As the result of this combined work Congress created the United States Entomological Commission, attaching to it Dr. Hayden's Survey, and the Secretary of the Interior appointed Charles V. Riley, A. S. Packard and Cyrus Thomas members of the Commission. Dr. Riley was appointed chief, and it was mainly owing to his executive ability, business sagacity, experience in official life, together with his scientific knowledge and practical inventive turn of mind in devising remedies, or selecting those invented by others, that the work of the Commission was so popular and successful during the five years of its existence. Meanwhile in 1878 while the report of the Commission was being printed, Riley accepted the position of Entomologist to the U. S. Department of Agriculture, and during the season of 1879 and 1880 he investigated the cotton insects, but owing to the lack of harmony in the Department, he resigned, Prof. J. H. Comstock being appointed, and ably filling the position. Congress meanwhile transferred the cotton-worm investigation to the Entomological Commission. Riley was reappointed to the position of U. S. Entomologist in June, 1881. His successor, Mr. L. O. Howard, has stated how efficient, broad and thorough was his administration of this office : "The present efficient organization of the Division of Entomology was his own original conception, and he is responsible for its plan down to the smallest detail. It is unquestionably the foremost organization of its kind at present in existence." Again he writes : "Professor Riley's work in the organization of the Division of Entomology has unquestionably advanced the entire Department of which it is a part, for it is generally conceded that this division has led in most matters where efficiency, discipline and system were needed. Its plan and discipline have been cited by one of the heads of the Department as worthy of imitation by all, and your own honored Westwood, in expressing, in 1883, his admiration of Riley's work, said : 'I am sure it must have had a great share in inducing the activity in entomological work in America, which is putting to the blush the entomologists of Europe.'"

Indeed, so efficient, methodical and painstaking was Riley in whatever he undertook to do that had he been promoted to the position of Commissioner of Agriculture he would have been head and shoulders above any incumbent of that office, and, it is safe to say, would have administered its affairs with practical results far more valuable than those attained by any other Commissioner, as such an office should have been entrusted to a person who had had a scientific education, and not given as a reward for political service. As it is, he was the leader, says Mr. Howard, in many important innovations in the work of the department. His division published the first bulletin, and in *Insect Life* began the system of periodical bulletins, which has since been adopted for the other divisions of the Agricultural Department. He also took a large share in founding the Division of Economic Ornithology, Silk Culture and Vegetable pathology, the first two being placed for some time under his charge. In an address, says Howard, before the National Agricultural Congress, delivered in 1879, in which he outlined the ideal Department of Agriculture, Professor Riley foreshadowed many important reforms which have since become accomplished facts, and suggested the important legislation, since brought about, of the establishment of State Experiment Stations under the general government.

His practical, inventive genius was exhibited in his various means of exterminating locusts, in the use of kerosene oil emulsified with milk or soap, and in his invention and perfection—in which he was essentially aided by the late Dr. W. S. Barnard, who had special charge of the subject of mechanical appliances and remedies while connected with the Entomological Commission and the Agricultural Department, and whose "assistance was fertile from the first," as stated by Riley in his report—of the "cyclone" or "eddy-chamber" or Riley system of nozzles, which, in one form or another, are now in general use in the spraying of insecticide or fungicide liquids.

Although the idea of introducing foreign insect parasites or carnivorous enemies of our imported pests had been suggested by others, Riley, with the resources of his division

at hand, accomplished more than any one else in making it a success. We will let Mr. Howard tell the story of his success, with the efficient aid of Mr. Albert Koebele, in introducing the Australian ladybird to fight the fluted scale :

"One other trait which we have not mentioned is his *persistency in overcoming obstacles.* Nothing daunts him, and the more difficult an end is to attain, so much the more energy and perseverance does he put in its pursuit. A recent instance of this quality we may cite : The fluted scale (*Icerya purchasi* Maskell) has done immense injury to citrus fruit in southern California of late years. Ascertaining that it is kept in check by natural enemies in its native home, Australia, Dr. Riley foresaw the importance of endeavoring to introduce these enemies. Not only did Congress refuse to appropriate money for the purpose, but it refused to do away with a clause in the Appropriation Bill restricting all expenditures to the United States. In this state of affairs most men would have given up the fight; but Dr. Riley, after great trouble, succeeded in accomplishing his end by inducing the Secretary of State to allow the sending of two assistants on the Melbourne Exposition Commission, and through their labors the desired result was reached. Hundreds of specimens of an Australian lay-bird (*Vedalia cardinalis*) were introduced into California, and the dreaded pest is now being speedily reduced to absolute harmlessness. Professor W. A. Henry, of Wisconsin, in a recently-published article, says of this matter, in speaking of the enthusiasm of the people of California over the results of this importation : 'Without doubt it is the best stroke ever made by the Agricultural Department at Washington.'"

It might be thought that all this administrative work of the office and in the field would have left little time for pure science or for much general reading or deep thinking. Let us see what he actually did accomplish in pure science. Riley's scientific writings will always stand, and show as honest work, thorough-going methods, care and accuracy as his office work, and they alone, aside from his practical work, were enough to give him an international reputation. In some of his studies he was probably essentially indebted to his assistants for specimens and aid in rearing them ; in others he evidently depended on his own unaided observations and his skill in drawing. He was not "a species man" or systematist as such ; on the contrary his most important work was on the transformations and habits of insects, such as those of the lepidoptera, locusts and their parasites, his Missouri reports being packed with facts new to science. His studies on the chronology of all the broods known of the seventeen-year cicada, and its *tredecim* or thirteen-year race, carried on through a long succession of years, will prove of lasting value, having intimate bearings on evolution problems.

His work on the larval characters and hypermetamorphoses of the blister beetles, Epicauta, Macrobasis and Hornia, besides Henous, was thoroughly good and beautifully illustrated by his own pencil. He brings forward in this paper a mass of new facts regarding the triungulin, or first larval stage of these beetles, and those succeeding, which he designates as the Carabidoid, the Scarabæidoid stage, the Coarctate or quiescent larva, these stages preceding the pupa stage. The value of these facts as set forth by so trustworthy and keen an observer, and corroborating and greatly extending those worked out by European observers, is apparent when we consider that the triungulin larva is perhaps the nearest approach to the Campodea-like ancestor of the winged insects, that the Meloidæ are consequently among the most primitive and generalized of Coleoptera, and that from work based on such studies as these of the life-history of this and allied groups there has already resulted the germs of a truer phylogeny or classification of the entire order of Coleoptera. Of similar import are Riley's papers on the larval habits of bee-flies, on the luminous larviform females of the Phengodini and on the first larval stage of the pea-weevil (Bruchus). His studies on the systematic relations of Platypsyllus as determined by the larva evince his patience, accuracy and keenness in observation and his philosophic breadth.

For over twenty years he made observations on the fertilization of Yucca by those remarkable tineoid moths, Pronuba and Prodoxus, and from time to time published papers and notices of progress in his work which culminated in his paper entitled, "The Yucca Moth and Yucca Pollination" (1891-'92), a memoir remarkable for the patient, unremitting work carried on during his spare hours, its thoroughness in dealing with structural details, its critical accuracy, and for its faithful and artistic drawings. It is a paper of interest to botanists as well as zoologists, and of value to the student of evolution. One of his last papers was a continuation and résumé of this subject, entitled "Some Interrelations of Plants and Insects" (1892).

Riley's contributions to the history and structure of the Phylloxera, of the scale insects, of the hop-plant louse, the Pemphiginæ, Psyllidæ, etc., are of permanent interest and value. His best anatomical and morphological work is displayed in his study on the mode of pupation of butterflies, the research being a difficult one, and especially related to the origin of the cremaster, and of the vestigial structures, sexual and others, of the end of the pupa. Whatever he did in entomology was original. He may occasionally have received and adopted hints and suggestions from his assistants, but he laid out the plan of work, supervised every detail, followed up the subject from one year to another, and made the whole his own. His originality in a quite different direction from biology is seen in his paper entitled "Perfectionnement du Graphophone," read before the French Academy of Sciences at Paris, in 1889. He was also much interested in Aëronautics, and took much delight in attending séances of spiritualists and exposing their frauds, in one case, at least, where another biologist of world-wide fame, then visiting in Washington, was completely deluded.

Riley was from the first a pronounced evolutionist. His philosophic breadth and his thoughtful nature and grasp of the higher truths of biology is well brought out in his address on "The Causes of Variation in Organic Forms," as Vice-President, before the biological section of the American Association for the Advancement of Science in 1888. He was a moderate Darwinian, and leaned, like other American naturalists, rather to Neo-Lamarckism. He says: "I have always had a feeling, and it grows on me with increasing experience, that the weak features of Darwinism and, hence, of natural selection, are his insistence (1) on the necessity of slight modification; (2) on the length of time required for the accumulation of modifications, and (3) on the absolute utility of the modified structure." Riley, from his extended experience as a biologist, was led to ascribe much influence to the agency of external conditions, remarking, in his address: "Indeed, no one can well study organic life, especially in its lower manifestations, without being impressed with the great power of the environment." He thus contrasts Darwinism and Lamarckism: "Darwinism assumes essential ignorance of the causes of variation and is based on the inherent tendency thereto in the offspring. Lamarckism, on the contrary, recognizes in use and disuse, desire and the physical environment, immediate causes of variation affecting the individual and transmitted to the offspring, in which it may be intensified again both by inheritance and further individual modification."

The following extracts will illustrate his clear and vigorous style of thought and expression and his attitude on the relations between science and religious philosophy. Regarding the question of design, he says: "Both Lyell and Gray believe in the form of variation having been planned or designed. It seems to me that the evidences of design in nature are so overwhelming that its advocates have an immense advantage over those who would discard it. A fortuitous cosmos is, to most persons, utterly inconceivable, yet there is no other alternative than a designed cosmos. To accomplish anything by a process, or by an instrument, argues greater, not less power, than to do it directly, and even if we knew to-day all the causes of variation, and understood more thoroughly than we do the method of evolution, we should only carry the sequence of causes a step further back and get no nearer to the Infinite or Original Cause."

"Evolution teaches that nothing is yet so perfect but it may be improved; that good comes of the struggle with evil and the one can never be dissociated from the other. The erect position which has given man his pre-eminence has brought him manifold bodily ills. No evolutional sibyl looks to a millennium. Higher development must ever mean struggle. Evolution shows that man is governed by the same laws as other animals." "Evolution reveals a past which disarms doubt and leaves the future open with promise—unceasing purpose—progress from lower to higher. It promises higher and higher intellectual and ethical attainment, both for the individual and the race. It shows the power of God in what is universal, not in the specific, in the laws of nature, not in departure from them."

"The experience gained by those who have reached the highest ethical and intellectual growth must be formulated in precept and principle to be of any benefit to society at large, and the higher ethical sentiment and religious belief—faith, love, hope, charity—are priceless beyond all that exact science can give it."

Riley, an excellent head of a bureau, but sometimes uncomfortable and too independent as a subordinate, at times got into hot water with his superiors in the Department. He was sensitive to criticism, and was somewhat prone to controversy, usually, however, winning in such encounters. Until one came to know him more intimately he was liable to be misunderstood, and by his occasional bluntness made some enemies, but as years rolled on these passing antagonisms melted away.

Vigorous in mind and body, though of late years suffering from overwork, fond of out-door sports, he was a fearless rider on horseback, and an adept with the bicycle, on which, alas, he rode to his death.

His hospitable house at Sunbury was beautified by rare flowers, shrubs and trees, of which he was passionately fond. He was domestic in his tastes, and left a wife and five children to mourn his loss.

Riley left an indelible mark on his time, and the historians of natural science and of agriculture in America will scarcely ignore the results of thirty years of earnest work in pure and applied entomological science.

His scientific honors were well deserved. He was a member of many societies at home and of the entomological societies of France, Berlin, Switzerland and Belgium. He was elected in 1889 an Honorary Fellow of the Entomological Society of London, and was also Honorary Fellow of the Royal Agricultural Society of Great Britain. He was for two years President of the Academy of Science of St. Louis, being the youngest member so honored. He was founder, and for two terms President, of the Entomological Society of Washington, one of the founders of the Biological Society of that city, and an honorary member of the horticultural societies of Illinois, Iowa, Kansas and Missouri. The Kansas State Agricultural College gave him the degree of A.M., and the Missouri State University, in 1873, conferred upon him the degree of Ph. D. He was lecturer on entomology at Cornell University and at other institutions.

A. S. PACKARD.

Brown University.

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